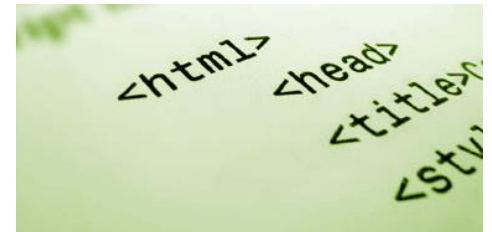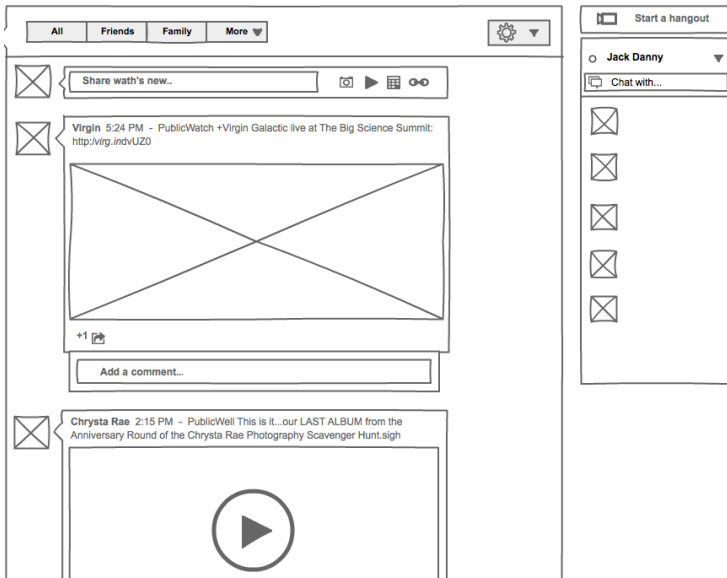# Cumbernauld Academy

# CfE Computing
# Web Design and Creation

This topic covers the following CfE outcomes:

**Digital Literacy 4-02a**
I can use digital technologies to process and manage information responsibly and can reference sources accordingly.

**Computing Science 4-14a**
I understand constructs and data structures in a textual programming language

**Computing Science 4-14b**
I can explain the overall operation and architecture of a digitally created solution.

**Computing Science 4-15a**
I can select appropriate development tools to design, build, evaluate and refine computing solutions to process and present information whilst making reasoned arguments to justify my decisions.

## Websites and Hyperlinks

- A **web page** is typically an HTML document which is stored on a computer connected to the Internet. All the web pages accessible via the Internet make up the **World Wide Web**.

- A **website** is a collection of web pages which are connected using **hyperlinks**.

- Web pages are viewed using a **web browser** (e.g. Internet Explorer, Google Chrome, Mozilla Firefox).

- Browsers provide several **navigation** features to help the user move between web pages (e.g. favourites, address bar, search bars, home button, back and forward buttons, history, tabs).

## URLs and Search Engines

- Every file that makes up the WWW has a unique **URL (Uniform Resource Locator)**, also known as the **web address**. For example: https://blogs.glowscotland.org.uk/nl/CAcad/

- If the URL for a web page is unknown then users can type **keywords** into a **search engine** (Google) to help them find pages.

## Web design and development: Analysis

During the analysis stage of website development, the following requirements need to be identified:

**End-user requirements**
- ♦ The end users are the people who are going to be using the website.
- ♦ Their requirements are the tasks they expect to be able to do using the website.

**Functional requirements**
- ♦ Processes and activities that the system has to perform.
- ♦ Information that the system has to contain to be able to carry out its functions.
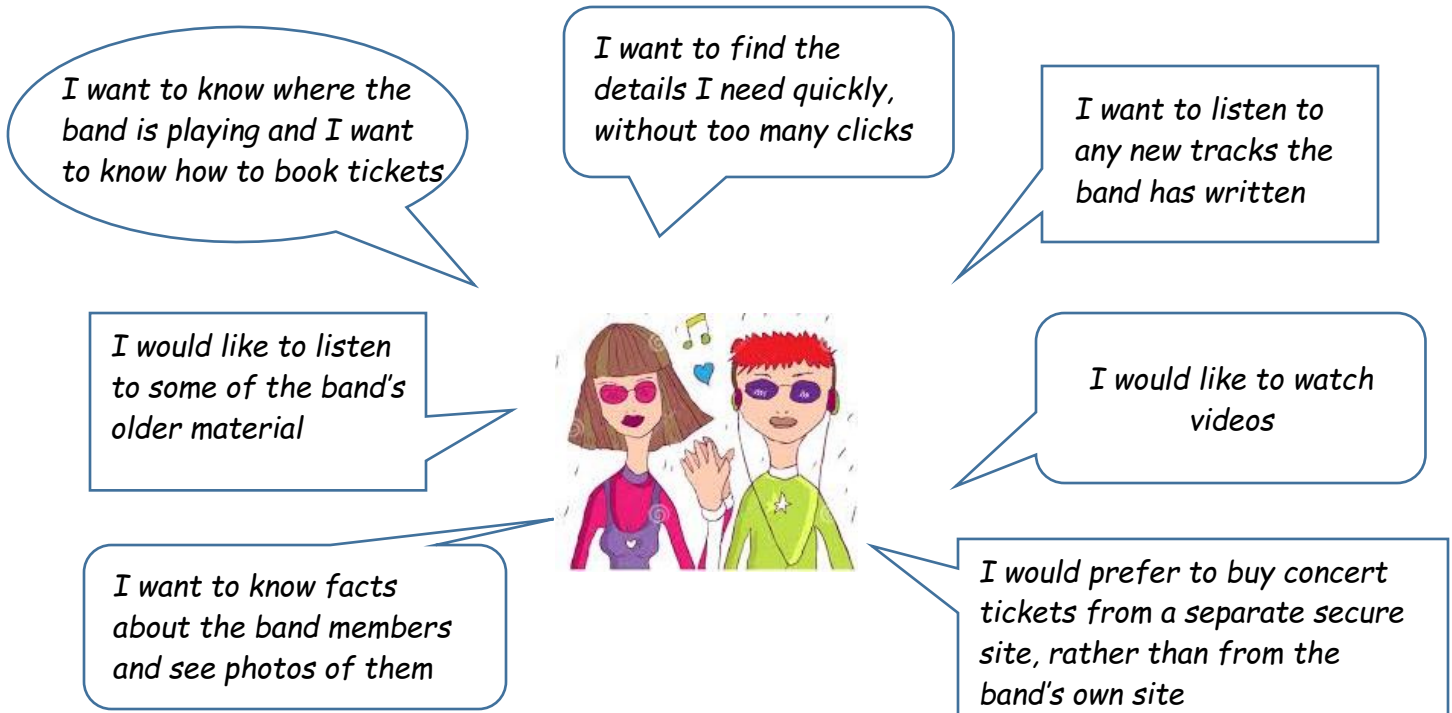
**These requirements will help:**
- ♦ clarify the design of each web page
- ♦ identify the features to be implemented on the website
- ♦ evaluate whether the system is fit for purpose after development is complete

A rock band has three members. The band wants to develop a website for its fans. The site will provide details about the band, including biographies, music tracks, video clips and concert details.

The band asked some of its fans what they would like to see on the new website. Here are a few of the comments they made.



*I want to know where the band is playing and I want to know how to book tickets*

*I want to find the details I need quickly, without too many clicks*

*I want to listen to any new tracks the band has written*

*I would like to listen to some of the band's older material*

*I would like to watch videos*

*I want to know facts about the band members and see photos of them*

*I would prefer to buy concert tickets from a separate secure site, rather than from the band's own site*

**End-user requirements:** Users should be able to:
♦ navigate the site easily
♦ view biographies and photos of band members
♦ view all upcoming concerts and link to an external booking site
♦ view video clips of the band
♦ listen to the band's audio tracks

**Functional requirements:** The website should be able to:
♦ The Home page should provide internal links to the four topic pages (biographies, music, videos and concerts).
♦ Individual profile pages should include biography information, with photos of the band member and should have a link back to the Biographies page.
♦ The Music page should list the band's albums and allow individual audio tracks to be played.
♦ The Videos page should list video clips and allow these to be played.
♦ The Concerts page should list all the upcoming concerts, with links to the external booking site.
♦ All pages (except the **Home** page) should link back to the **Home** page.

## User Interface Design:  Wireframe

The User Interface Design can be illustrated using a **wireframe.**  A wireframe is a sketched design for the user interface of a web page.  A wireframe can be thought of as a template of the site's web pages. Pictures can be represented by a crossed box, main headings will be shown but with lines to represent normal page text.  A separate wireframe is required for each page of a website.



Each wireframe indicates the intended layout of the page and shows the position of:
- all text elements on the page
- any media elements (images, audio clips and video clips)
- elements that allow the user to interact with the page (forward, back buttons etc)
- intended position and type of all hyperlinks on the page


Good user interface design should take into account:

- **Visual layout** – making sure the screen is uncluttered, easy to take in and aesthetically pleasing.

- **Navigational Links** – making sure it is easy to find your way about the website.

- **Consistency Across Multiple Pages** – consistent use of a font, colour scheme, positioning of navigation buttons, etc makes a website easier to become familiar with.

- **Readability** – ensuring text is easy to read, taking into account font size, spacing, colours, etc.

- **File Formats of Media** – (text, graphics, video and audio)

## Example of a basic Wireframe Design of a Web Page
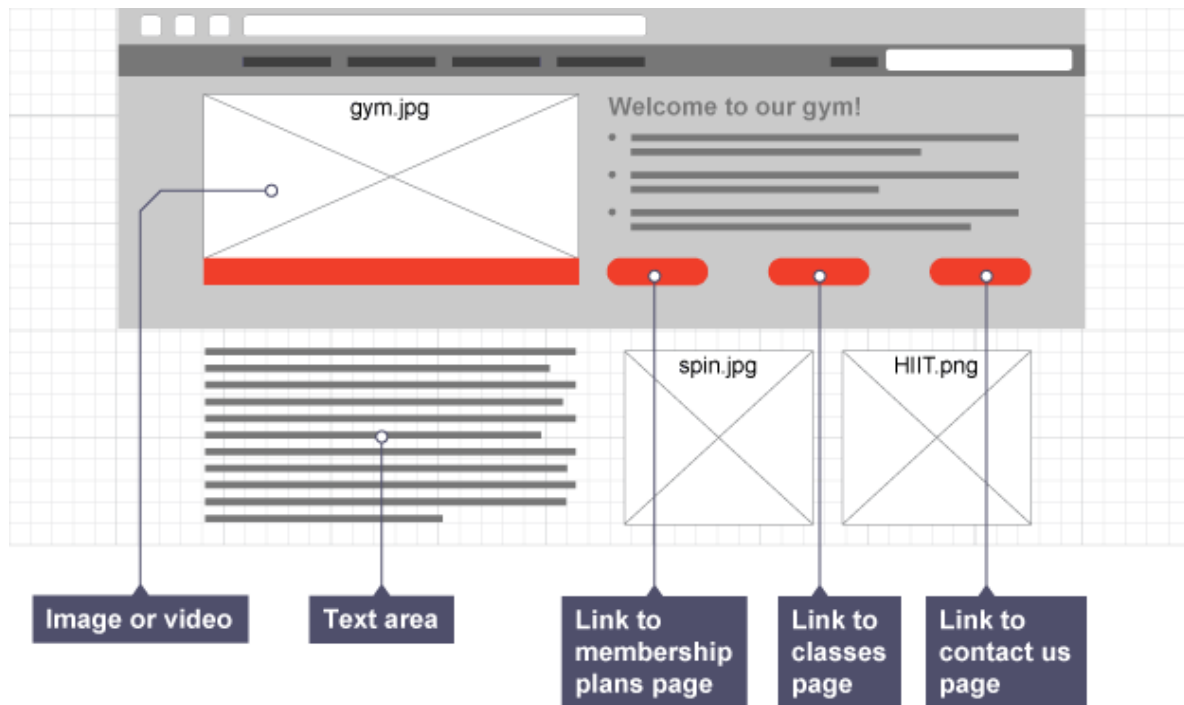


The parts of the wireframe that look like large envelopes are used to signify images or videos. The horizontal lines symbolise text areas with the parts shown in orange/red signifying a link. There are variations on the way that different elements are represented but the key points remain the same.

## Example of Wireframe for ScotsWaterSport

A new website for ScotsWaterSport is being developed. The website will consist of five web pages and each of these web pages will have a main heading centred at the top of the page. Further requirements for the web pages are provided below.
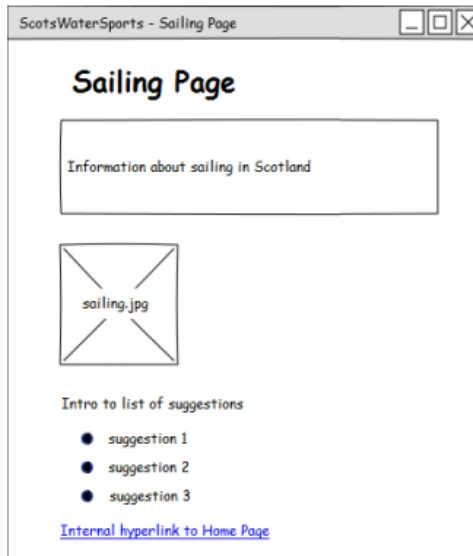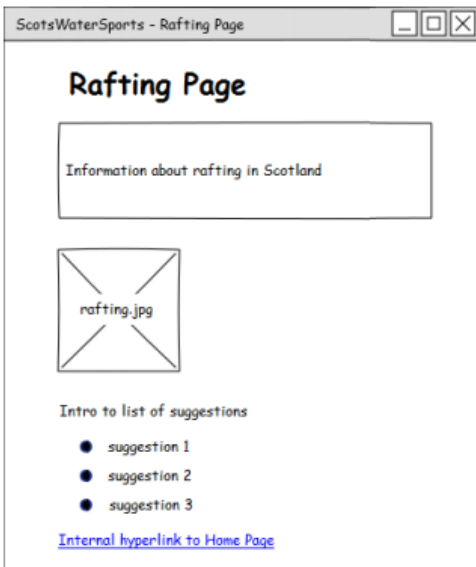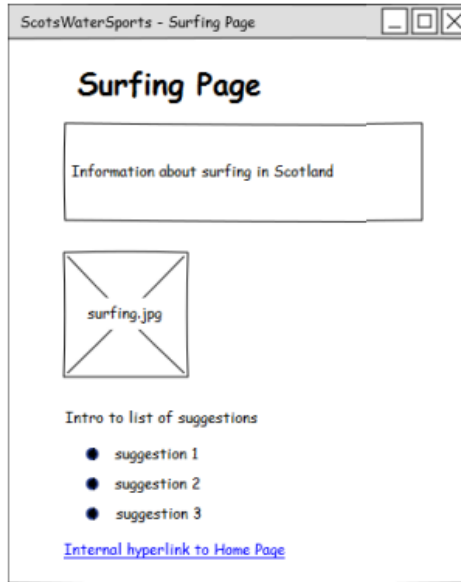
The home page will provide:
- a short introduction to the range of water sports available in Scotland
- internal hyperlinks to specialist pages about four different water sports
- (Kayaking, Surfing, Rafting and Sailing)
- one external link to the water sports page of the Visit Scotland website

Each of the specialist sports pages will provide:
- a paragraph of information about the sport
- a photo of the sport
- a bulleted list of suggested locations to try out the sport
- a hyperlink back to the home page

The wireframe is on the next page:

### ScotsWaterSports - Home Page

## ScotsWaterSports HomePage

Intro parragraph

Internal hyperlink to Kayaking Page

Internal hyperlink to Surfing Page

Internal hyperlink to Rafting Page

Internal hyperlink to Sailing Page

External hyperlink to Visit Scotland Page about water sports

---

### ScotsWaterSports - Kayaking Page

## Kayaking Page

Information about kayaking in Scotland

kayaking.jpg

Intro to list of suggestions
- suggestion 1
- suggestion 2
- suggestion 3

Internal hyperlink to Home Page

---

### ScotsWaterSports - Surfing Page

## Surfing Page

Information about surfing in Scotland

surfing.jpg

Intro to list of suggestions
- suggestion 1
- suggestion 2
- suggestion 3

Internal hyperlink to Home Page

---

### ScotsWaterSports - Rafting Page

## Rafting Page

Information about rafting in Scotland

rafting.jpg

Intro to list of suggestions
- suggestion 1
- suggestion 2
- suggestion 3

Internal hyperlink to Home Page

---

### ScotsWaterSports - Sailing Page

## Sailing Page

Information about sailing in Scotland

sailing.jpg

Intro to list of suggestions
- suggestion 1
- suggestion 2
- suggestion 3

Internal hyperlink to Home Page

## Low-Fidelity Prototyping

A prototype is used to show the intended user interface for any software product.  A **low-fidelity prototype** is paper-based. They can be created quickly and give potential end users of the finished product an indication of how the product will look and feel as they interact with it.

Prototypes should be based on the layout indicated in the wireframes. However, unlike wireframes which are created to ensure consistency and share details with members of the development team, the intended audience of prototypes is end users of the finished product. For this reason, a prototype should show more details for the content and the screen widgets that will be used to perform tasks.

## Creating Low-Fidelity Prototypes

Low-fidelity prototypes can be created in a number of ways. For example:
- A simple hand-drawn sketch of the proposed interface is one of the easiest and cheapest ways of creating a paper-based prototype. Coloured pencils, felt pens and markers can be used to add colour; quick hand drawings of images and widget icons will give end users a good idea of what is intended. Any size of paper can be used but flip-chart paper can be easier for candidates to handle and facilitates collaborative group work.
- 'Pencil' software by 'Evolus' provides free prototyping tools. A number of in-built templates are provided and additional Android and iOS templates are available for download. 'Pencil' templates can be used to create realistic-looking interfaces that can be exported as PNG files and printed to generate prototypes for usability testing. See http://pencil.evolus.vn/
- Graphics packages such as 'Paint' can be used to create the intended layout using tools provided in the toolbox. See https://www.getpaint.net/

## Example of Low-Fidelity Prototype for ScotsWaterSport

A new website for ScotsWaterSport is being developed. The wireframes for each of the pages have been created and prototyping of the Home Page and the Kayaking Page of the ScotsWaterSports website can now take place.

**Version 1:** These prototypes were created with marker pens and flip-chart paper.
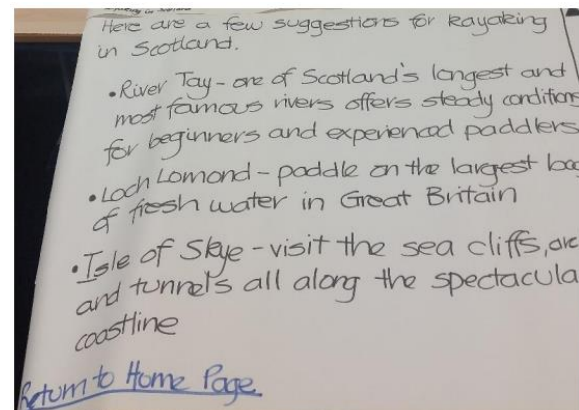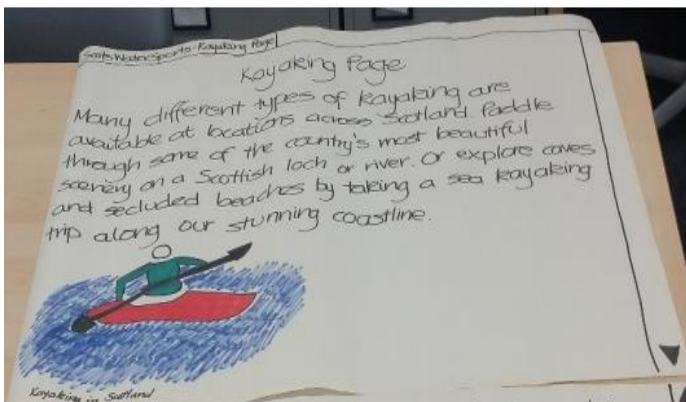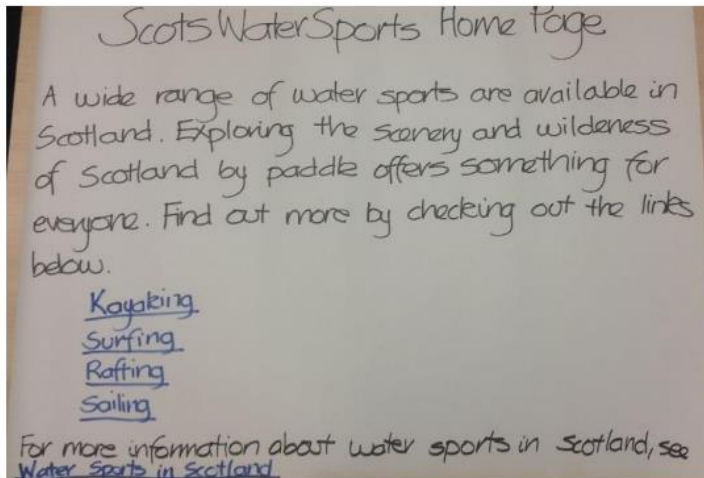
**Version 2:** These prototypes were created using 'Pencil' templates

ScotsWaterSports - Home Page

# ScotsWaterSports Home Page

A wide range of water sports are available in Scotland. Exploring the scenery and wilderness of Scotland by paddle offers something for everyone. Find out more by checking out the links below.

Kayaking

Surfing

Rafting

Sailing

For more information about water sports in Scotland, see  Water Sports in Scotland

ScotsWaterSports - Kayaking Page

# Kayaking Page

Many different types of kayaking are available at locations across Scotland. Paddle through some of the country's most beautiful scenery on a Scottish loch or river. Or explore caves and secluded beaches by taking a sea kayaking trip along our stunning coastline.

*White water kayaking in Scotland*

Here are a few suggestions for kayaking in Scotland.

- River Tay - one of Scotland's longest and most famous rivers offers steady conditions for beginners and experienced paddlers
- Loch Lomond - paddle on the largest body of fresh water in Great Britain
- Isle of Skye - visit the sea cliffs, arches and tunnels all along the spectacular coastline

Return to Home Page

## HTML (HyperText Markup Language)

HTML is a computer language used to describe what is to appear on a web page, using a variety of tags.

- HTML is created using a text editor, such as Notepad++.

- Most HTML tags have an opening tag and a closing tag (with a / symbol).


An HTML document is split into:
- Head section (not displayed on the web page)
- Body section (displayed on the web page)

An HTML page is made up of **elements**. The HTML element is everything from the start tag to the end tag:

`<p>My first paragraph.</p>`

Each element has a **start tag** and an **end tag** with content in between.

HTML elements with no content are called **empty elements**. Empty elements do not have an end tag, such as the <br>or <hl> elements (which indicates a line break and a horizontal line).

```
<!DOCTYPE html>
<html>
   <head>
      <title>My Web Page</title>
   </head>

   <body>

      <h1>My Great Web Page</h1>
      <p>Hello, and welcome to my web page!</p>

   </body>
</html>
```
Start tags

```
<!DOCTYPE html>
<html>
   <head>
      <title>My Web Page</title>
   </head>

   <body>

      <h1>My Great Web Page</h1>
      <p>Hello, and welcome to my web page!</p>

   </body>
</html>
```
End tags

```
<!DOCTYPE html>
<html>
   <head>
      <title>My Web Page</title>
   </head>

   <body>

      <h1>My Great Web Page</h1>
      <p>Hello, and welcome to my web page!</p>

   </body>
</html>
```
Content

**Elements** can also contain **attributes**.  These provide additional information about the element.  For example, the <img> tag below uses attributes to provide more information about the image element.

```
<img src="my_image.jpg" width="200" height="150">
```

- Src – the source file location and name
- Width – the width the image should be displayed at
- Height – the height the image should be displayed at

Some basic HTML tags you should learn how to use:

| Tag | Notes | Example |
|-----|-------|---------|
| <html> | • This tells your web browser that a page with HTML is coming up | `<html>`<br>`....`<br>`</html>` |
| <head> | • This tag includes all information about the page itself, its title and links to JavaScript and CSS files. The data held within the head section is not seen by the user when the web page loads.<br>• | `<head>`<br>`<title>CA Web Page</title>`<br>`</head>` |
| <title> | • This states the title of the web page. The title will appear as text on browser window tabs.<br>• | `<title>CA Web Page</title>` |
| <body> | • This states where the actual content of the page begins and ends. Here the content is entered.<br>• | `<body>`<br>`....`<br>`</body>` |
| <h1> | • Used to display a heading.<br>• <h1> is the main heading, <h2> is the first sub-heading, and so on as far as <h6>. | `<h1>Cumbernauld Academy</h1>` |
| <p> | • Used to create a paragraph with a blank line before and after. | `<p>Welcome to Cumbernauld Academy</p>` |
| <br> | • Line break (takes a new line). | `This is an example<br>of a line break` |
| <hr> | • Horizontal rule (draws a line) | `<p>Cumbernauld Academy is a high school in Cumbernauld.</p>`<br>`<hr>`<br>`<p>The head teacher is Mr Cairns.</p>` |

| | | |
|---|---|---|
| `<b>` | • Bold text | `Computing is <b> amazing!</b>` |
| `<i>` | • Italic text | `I <i> love </i> Computing.` |
| `<a>`<br><br>`<a href..>` | • Anchor tag<br>• Hyperlink<br>• The *href* attribute is used to specify the destination of the hyperlink. | **Internal Hyperlink**<br>`Click <a href="Comp.html">here</a>`<br><br>**External Hyperlink**<br>`Click <a href=" http://bbc.co.uk/">here</a> for the BBC Website` |
| `<img>` | • Image<br>• The *src* attribute is used to specify the filename of the image.<br>• The alt attribute provides alternative text for an image which will be displayed if the image cannot be loaded.  It can also be read by an image reader. | `<img src="computer.jpg" alt="A description of the image" height="24" width="24">`<br><br>**Images as Hyperlinks**<br>`<a href="Comp.html">`<br>`<img src="computer.jpg" alt="A description of the image" height="24" width="24">`<br>`</a>` |
| `<ol>`<br><br>`<li>` | • Defines an ordered list<br><br>• Defines a list item | `<ol>`<br>`   <li>Mrs Donald</li>`<br>`   <li>Miss Carrick</li>`<br>`   <li>Miss McGarry</li>`<br>`   <li>Mrs Johnston</li>`<br>`</ol>` |
| `<ul>` | • Defines an unordered list (bullets) | `<ul>`<br>`   <li>Mrs Donald</li>`<br>`   <li>Miss Carrick</li>`<br>`   <li>Miss McGarry</li>`<br>`   <li>Mrs Johnston</li>`<br>`</ul>` |
| `<div>` | • Defines a division or a section<br>• Used to group block-elements to format them with CSS | `<p>Computing Science</p>`<br>`<div style="color:red">`<br>`<h3>Software Development</h3>`<br>`<h3>Web Design</h3>`<br>`</div>`<br>`<p>Administration & ICT"</p>` |
| `<audio>` | • The `<audio>` tag defines sound, such as music or other audio streams. | `<audio controls>`<br>`<source src="Sound.mp3" type="audio/mp3">`<br>`</audio>` |
| `<video>` | • The `<video>` tag specifies video, such as a movie clip or other video streams. | `<video width="220" height="150" controls>`<br>`<source src="Video.mp4" type="video/mp4">`<br>`</video>` |

## Other languages used to make web pages

HTML provides the structure of a web page but many websites also use other languages such as:

- **CSS** – used to change the look and style of web pages in a more efficient way.

- **JavaScript** – used to add interactivity to a web page.

- **PHP** – used to create dynamic web pages which can change their content.

- **SQL** – used to work with an online database.
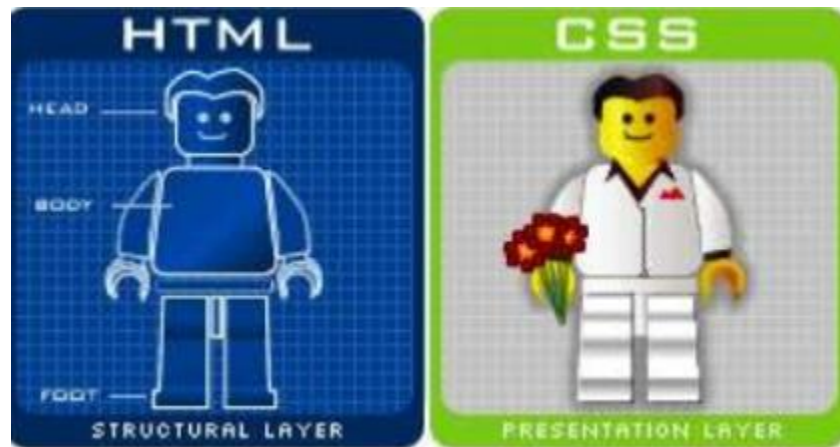


## Testing

A website should be checked methodically to ensure that:

- every hyperlink takes the user to the correct destination
- graphics display correctly
- text is correct and matching design
- videos and audio play correctly

## File Formats

- Choosing the correct file format for media such as graphics, audio or video is very important.

- Keeping file sizes small means web pages and their content load more quickly.

- Many file formats allow the file to be **compressed** to reduce the file size. Compression can be **lossy** (loses quality as it is compressed) or **lossless** (doesn't lose quality when compressed).

## Audio File Formats:

| File format | Information |
|---|---|
| WAV | Lossless compression.  Allows audio recordings to be saved with different sampling rates and bitrates; often saved in a 44.1 KHz, 16-bit, stereo format, which is the standard format used for CD audio. WAV has a better sound quality than MP3. |
| MP3 | Lossy compression.  Can reduce an original sound file to ten to fifteen times smaller than the parent file. The small file that is produced is easy and quick to download and is perfect for web use. MP3 takes up less memory and is faster to download than WAV.  MP3 has a worse sound quality than WAV. |

## Graphic File Formats:

| File format | Information |
|---|---|
| JPEG | Lossy compression, ideal for still images and photography.  It uses compression to reduce file sizes, which leads to the loss of some of original data. Quick to download. It supports full colour. It is a 24-bit format and is capable of showing images containing over 16 million colours. |
| GIF | Lossless compression.  Mainly used on web for images with sharp content such as logos, screenshots and basic animations. It is a 8-bit format and is capable of showing images containing 256 colours, so it is not suitable for photographs.  GIF is suitable for simple animations, graphics with flat colors, graphics without gradients and transparent images. |
| PNG | Lossless compression, ideal for photos.  PNG produces smaller file sizes than GIF images but PNG is slower to upload and download.  It allocates 24 bits per pixel and is capable of showing images containing over 16 million colours.  PNG is suitable for transparency but does not cannot be animated. Great for icons. |

## File Compression

Graphic, video and audio files can have a very large file size.   Compression techniques are used to reduce the size of large multimedia files.  Lossless compression results in no reduction in quality but lossy compression reduces the quality of the file.

There are two main advantages of compressing large files:
- Compressed files require less backing storage space and memory
- Compressed files can be transferred faster over the Internet or a computer network since there are a smaller number of bits to be transferred.

## Factors Affecting File Size

The quality of graphics, video and audio files is determined by factors such as resolution, colour depth and sampling rate.  As a computer has a limited amount of storage space in main memory and backing storage, there has to be a balance between improving the quality by increasing the resolution (the number of pixels in the height and width of the image), colour depth (number of bits used to store each pixel) and sampling rate and the very large file sizes that result from this, since more bits are needed to be used to store the extra details.

## Resolution of an Image

The resolution is the number of pixels in the height and width of the image.  The resolution is also referred to as the number of dots per inch.

High Resolution Graphic - Large number of small pixels
Low Resolution Graphic - Small number of large pixels

|  | No of Pixels | Size of Pixels | File Size of Image | Quality of Image |
|---|---|---|---|---|
| **Increase resolution** | Increased (more) | Decrease (smaller) | Increased (larger) | Increased (better) |
| **Reduce resolution** | Reduced (less) | Increase (larger) | Reduced (smaller) | Reduced (poorer) |

Below is an illustration of how the same image might appear at different pixel resolutions:



| Canvas Size: | 20 x 20 px | 40 x 40 px | 200 x 200 px |
|---|---|---|---|
| Resolution: | 9 DPI | 18 DPI | 90 DPI |
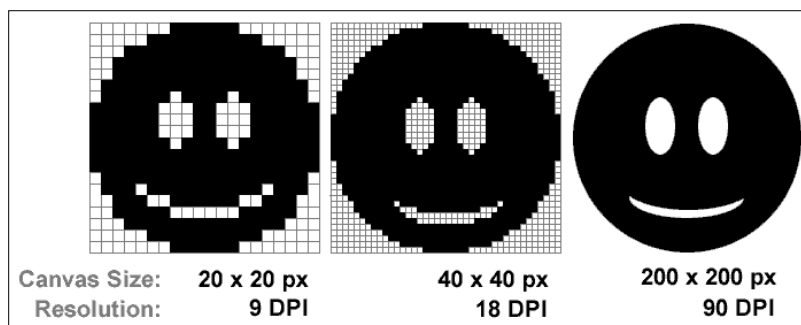
## Colour Depth of an Image

Bit-mapped graphics use binary codes to represent the colour of each pixel.  The colour depth (bit depth) is the number of bits used for the colour code of each pixel in an image.

- An image which uses 1-bit colour depth will only be able to store two colours (black & white) ($2^1$).
- An image which uses 2-bit colour depth will be able to store four colours or shades of grey ($2^2$).
- An image which uses 8-bit colour depth can store 256 colours ($2^8$).
- An image which uses 24-bit colour depth (true colour) can store 16,777,216 colours ($2^{24}$).

|  | Number of Colours | Download Speeds | File Size of Image | Quality of Image |
|---|---|---|---|---|
| **Increase colour depth** | Increased (more colours available) | Increased (take longer) | Increased (larger) | Increased (better) |
| **Reduce colour depth** | Decreased (less colours available) | Reduced (quicker) | Reduced (smaller) | Reduced (poorer) |

The pictures below show you how the same graphic would be represented depending on the bit depth.  You can easily see that the picture with the greatest bit depth has the highest quality:
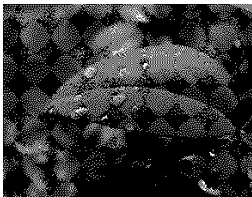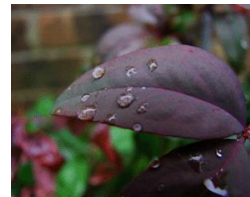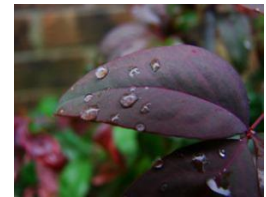


1 bit:
2 colours
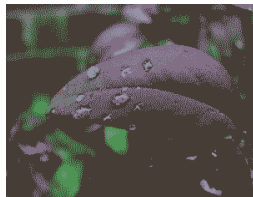
2 bits:
4 colours

4 bits:
16 colours

8 bits:
256 colours

24 bits:
16,777,216 colours

## Sampling Rate of an Audio File

Digital sound is created by taking a sample of a sound many times every second.  The sampling rate is the number of times that the sound is sampled per second.  A higher sample rate will result in a better-quality digitised sound but will increase the file size, as more sound samples are stored per second.  Sampling rates are of the order of many thousands of times per second.  Common sampling frequencies are 44KHz, 22KHz and 11KHz. This means that the sound is sampled 44,000, 22,000, 11,000 times per second. For example, the current sample rate for CD-quality audio is 44,100 samples per second.  Reducing the sampling rate decreases the quality of the sound but decreases the amount of memory needed to store the audio, as less sound samples are stored per second.