G.C.E. O/L Grade 11 ICT · Lesson 4

4.1 Digital Images: Pixels, Resolution, Colour Depth, Raster and Vector Graphics

Syllabus 13.1. Posters for Science Day, photos on the school website, a birthday card in Canva – all of these are **still graphics** (pictures that do not move). In this note you will learn what **multimedia** is, what a **pixel**, **resolution** and **colour depth** are, how to **calculate the file size** of an image, the difference between **lossy and lossless** formats and between **raster and vector** graphics, and how to edit a picture in **GIMP** with layers, selections, crop, resize and text. Finally you will learn to use **AI images** responsibly.

1. What is multimedia?

Multimedia means using **more than one kind of media together** to share an idea. The five media elements are **text, images (graphics), audio, video and animation**. When the user can click, choose or control what happens (like a quiz or a game), it is **interactive multimedia**.

Text පෙළ	**Images** රූප
Audio ශ්‍රව්‍ය	**Video** වීඩියෝ
Animation සජීවීකරණය	

2. Pixels – the dots that make a picture

A digital image is a grid of tiny coloured squares called **pixels** (picture elements). Zoom in on any photo and you will see them. The **size** of an image is written as **width × height in pixels**, for example **1024 × 768**. That picture has 786,432 pixels. A phone camera of 4000 × 3000 makes 12,000,000 pixels = **12 megapixels (MP)**.

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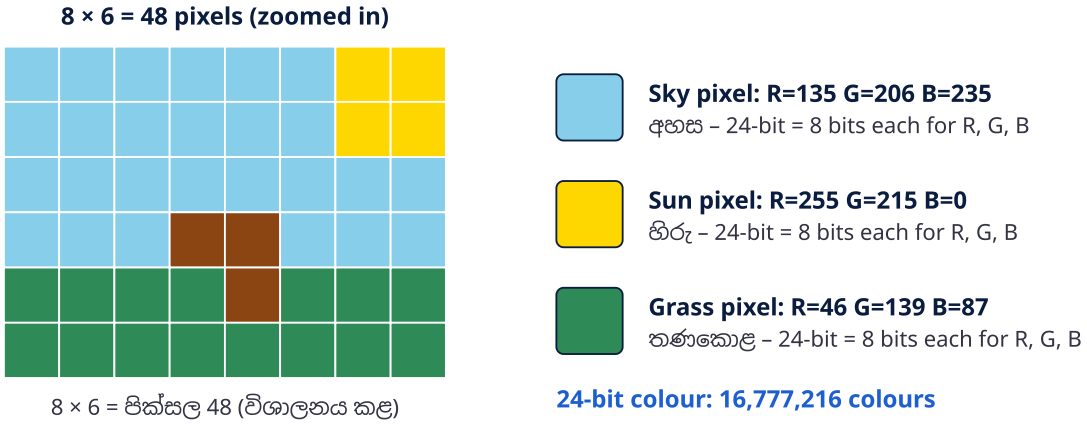


Figure 4.1 – A tiny picture zoomed in: each square is one pixel with its own RGB colour.

3. Resolution – PPI and DPI

Resolution tells how many pixels are packed into each inch. On a screen it is **PPI (pixels per inch)**; for a printer it is **DPI (dots per inch)**. More pixels per inch = sharper, more detailed picture. To find the printed size: **inches = pixels ÷ PPI**. A 1800 × 1200 photo printed at 300 PPI is 6 × 4 inches – a normal 6 × 4 photo.

4. Colour and colour depth

Screens make every colour by mixing **Red, Green and Blue (RGB)** light. Each pixel stores numbers for R, G and B (0–255 each). **Colour depth** (bit depth, **bpp** = bits per pixel) is the number of bits used for one pixel. With **n bits** a pixel can show **2^n colours**.

Colour depth	Number of colours (2^n)	Used for
1-bit	2	Black and white only
8-bit	256	GIF images, old screens
16-bit	65,536	“High colour”
24-bit	16,777,216	“True colour” – normal photos

> 💡 To find bits needed for a number of colours, find the smallest n with $2^n \geq$ colours. 64 colours → $2^6 = 64$ → **6 bits**.

5. Calculating image file size

For an **uncompressed** image (like BMP): **File size (bytes) = width × height × colour depth ÷ 8**. Divide by 1024 for KB and again by 1024 for MB. Worked example: 1024 × 768, 24-bit → 1024 × 768 × 24 = 18,874,368 bits ÷ 8 = 2,359,296 bytes ÷ 1024 = 2304 KB ÷ 1024 = **2.25 MB**.

Image	Size (pixels)	Colour depth	Bytes	File size

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School logo scan (black and white)	100 × 100	1-bit	1,250	1.22 KB
Old 256-colour web image	640 × 480	8-bit	307,200	300 KB
Class photo for the school website	1024 × 768	24-bit	2,359,296	2.25 MB
Full HD screenshot of e-thaksalawa	1920 × 1080	24-bit	6,220,800	5.93 MB

> 💡 Remember the order: **pixels → bits → bytes (÷ 8) → KB (÷ 1024) → MB (÷ 1024)**.

6. Compression – lossy and lossless

Compression makes files smaller so they load faster and take less space. **Lossy** compression (JPEG) throws away detail the eye hardly notices – very small files, but quality drops each time you save again. **Lossless** compression (PNG, GIF, TIFF) makes the file smaller **without losing any detail**. BMP is usually **uncompressed**. Example: a 2.25 MB BMP class photo might become about 230 KB as a JPEG – roughly 10 times smaller.

Format	Compression	Best for
JPEG (.jpg)	Lossy	Photos; small files; quality slider
PNG (.png)	Lossless	Logos, screenshots, transparency
GIF (.gif)	Lossless	Only 256 colours; simple animation
BMP (.bmp)	Uncompressed	Very large files
TIFF (.tif)	Lossless	Printing and scanning
SVG (.svg)	Vector	Shapes as maths; any size, always sharp

> NEW 2026 **2026: WebP** and **AVIF** are modern web formats that can be lossy or lossless and are often smaller than JPEG and PNG. Most browsers and Canva support them.

7. Raster and vector graphics

Raster (bitmap) images are made of pixels. When you enlarge them too much they become **blocky (pixelated)**. **Vector** images store **shapes as mathematics** – lines, curves and fills. You can enlarge a vector logo to the size of a school banner and it **stays sharp**, and the file is usually small.

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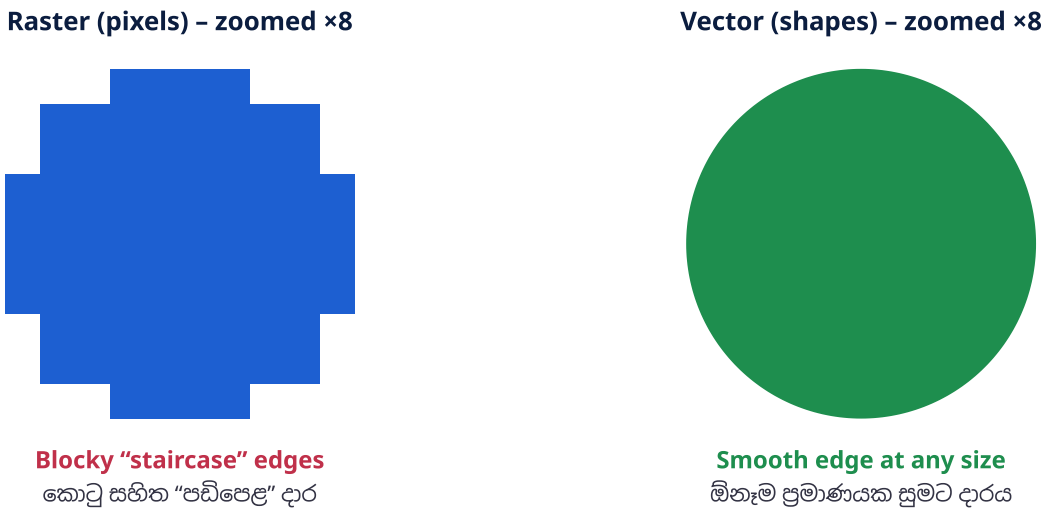


Figure 4.2 – Zoomed in, the raster circle shows pixel steps; the vector circle stays smooth.

Feature	Raster	Vector
Made of	Pixels (a grid of dots)	Shapes: lines, curves, fills (maths)
Enlarging	Becomes blocky (pixelated)	Stays sharp
Best for	Photos, paintings	Logos, icons, maps, diagrams
File types	JPEG, PNG, GIF, BMP, TIFF	SVG, AI, CDR, EPS
Software	GIMP, Photoshop	Inkscape, Illustrator, CorelDRAW

8. Graphics software

GIMP
GIMP

Adobe Photoshop
Adobe Photoshop

Inkscape
Inkscape

Canva
Canva

9. Editing a picture – basic operations

Example task: make a **Science Day 2026** poster for your school. You open a photo, crop it, add the school logo, write a title and export it. These are the operations you will use (menus shown for GIMP; Photoshop is very similar).

Operation	How (GIMP)
Open / Save / Export	File > Open; Save keeps layers (.xcf); Export makes JPEG or PNG
Import	File > Open as Layers adds a picture as a new layer
Resize (scale)	Image > Scale Image; keep the chain locked to keep the shape
Rotate / Flip	Image > Transform > Rotate 90° or Flip Horizontally

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Select	Rectangle, Ellipse, Free (lasso) or Fuzzy (magic wand) select
Cut / Copy / Paste	Edit > Cut (Ctrl+X), Copy (Ctrl+C), Paste (Ctrl+V)
Crop	Crop tool – keep only the part you need
Replace	Select an area, then paste another picture or fill a new colour
Layers	Windows > Layers; each object on its own layer
Text and effects	Text tool; then drop shadow, outline, gradient

Layers are like clear plastic sheets stacked on top of each other. Put the background, photo, logo and text on separate layers. Then you can move or change the text without damaging the photo. Save the working file as **.xcf** (GIMP) or **.psd** (Photoshop) to keep the layers; **export** a JPEG or PNG to share.

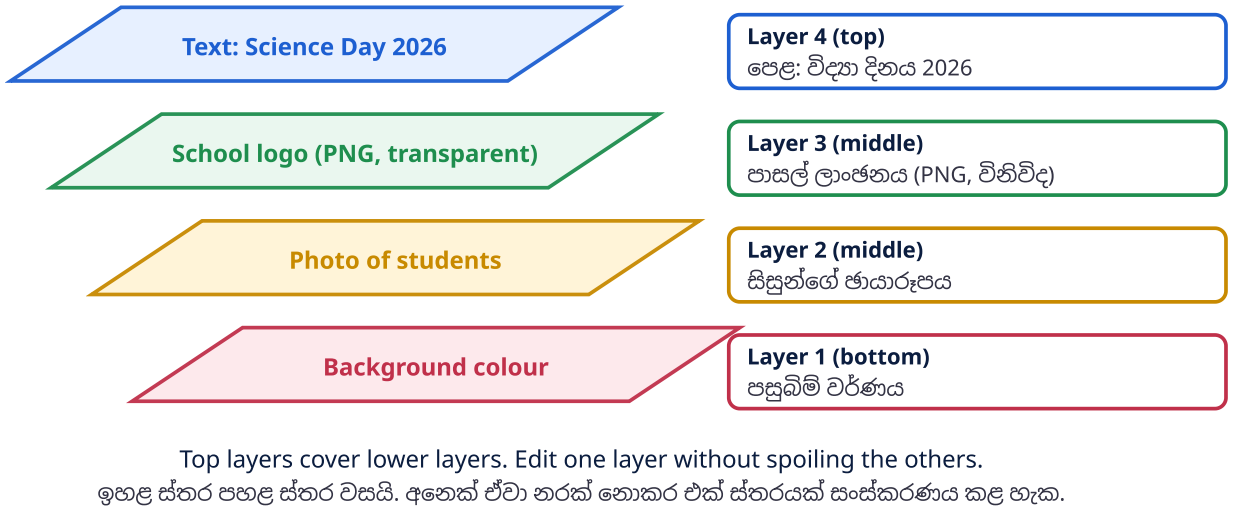


Figure 4.3 – The layers of a Science Day poster: text on top, background at the bottom.

> 💡 **Crop** removes the outside of a picture (the canvas gets smaller). **Resize/scale** keeps the whole picture but changes its pixel size. Do not mix them up!

10. AI images, copyright and credit

> NEW 2026 **2026:** Tools like Canva Magic Media, Adobe Firefly and Photoshop **Generative Fill** can create or change images from a text prompt. Use them responsibly: **say when an image is AI-made**, never make fake pictures of real people (**deepfakes**) to trick or bully, and do not copy another artist's work.

Photos you find on Google are usually **copyright** – the owner decides who may use them. Use your **own photos**, or images with a **Creative Commons** licence, and **give credit** (name of the creator and the source).

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Licence	Meaning
CC BY	Use it, but give credit
CC BY-SA	Give credit and share your new work the same way
CC BY-NC	Give credit; no commercial use
CC0	Public domain – free to use

Key Words

Multimedia – Using text, images, audio, video and animation together.

Interactive multimedia – Multimedia the user can control by clicking or choosing.

Pixel – The smallest coloured square in a digital image.

Resolution – Pixels per inch (PPI) or dots per inch (DPI).

Colour depth – Bits used for one pixel; n bits give 2^n colours.

RGB – Red, Green and Blue light mixed to make screen colours.

Lossy compression – Makes files smaller by removing some detail (JPEG).

Lossless compression – Makes files smaller with no loss of detail (PNG).

Raster graphic – An image made of pixels; blurs or blocks when enlarged.

Vector graphic – An image made of shapes; stays sharp at any size.

Layer – A separate sheet in an image that can be edited alone.

Crop – Cutting away the outer parts of a picture.

Sample Q&A

1. Name the five elements of multimedia.

> **Answer:** Text, images, audio, video and animation.

2. How many colours can a 24-bit image show?

> **Answer:** 2^{24} = 16,777,216 colours.

3. Find the size of a 640 × 480, 8-bit image.

> **Answer:** 640 × 480 × 8 ÷ 8 = 307,200 bytes = 300 KB.

4. Why is a school logo better saved as a vector?

> **Answer:** It stays sharp at any size, from a badge to a banner.

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5. What is the difference between lossy and lossless?

> **Answer:** Lossy removes some detail (JPEG); lossless keeps all detail (PNG).

6. Why use layers?

> **Answer:** So each part can be edited or moved without spoiling the others.

MCQ

1. Which is NOT one of the five multimedia elements?

A. Keyboard
B. Text
C. Animation
D. Audio

2. The smallest element of a digital image is a

A. vector
B. frame
C. pixel
D. layer

3. A phone camera takes 4000 × 3000 photos. How many megapixels?

A. 7 MP
B. 1.2 MP
C. 12 MP
D. 120 MP

4. How many colours can an 8-bit image show?

A. 256
B. 64
C. 8
D. 16

5. How many bits per pixel are needed for 64 colours?

A. 4
B. 6
C. 8
D. 64

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6. A black-and-white (1-bit) image can show

A. 1 colour
B. 256 colours
C. 8 colours
D. 2 colours

7. File size of an uncompressed 1024 × 768, 24-bit image is

A. 768 KB
B. 24 MB
C. 2.25 MB
D. 18 MB

8. A 1800 × 1200 photo printed at 300 PPI is

A. 18 × 12 inches
B. 6 × 4 inches
C. 60 × 40 inches
D. 3 × 2 inches

9. Which format uses lossy compression?

A. JPEG
B. PNG
C. BMP
D. TIFF

10. A logo with a transparent background should be saved as

A. JPEG
B. BMP
C. PNG
D. MP3

11. Which is a vector file format?

A. GIF
B. BMP
C. JPEG
D. SVG

12. When a raster image is enlarged too much it becomes

A. pixelated (blocky)
B. smaller in file size
C. sharper
D. a vector

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13. Which software is mainly a free vector editor?

A. Audacity
B. Inkscape
C. GIMP
D. Photoshop

14. Removing the unwanted outer edges of a photo is called

A. rotate
B. export
C. flip
D. crop

15. Before using a photo from the Internet in a school poster you should

A. remove the owner's name
B. check its licence and give credit
C. use it – everything online is free
D. change it with AI so it is yours

Structured Questions

1. (i) What is a pixel? (1 mark)
(ii) Calculate the uncompressed file size of a 640 × 480, 8-bit image in KB. Show working. (3 marks) *(4 marks)*

> (i) The smallest coloured square of a digital image (1). (ii) 640 × 480 × 8 = 2,457,600 bits (1); ÷ 8 = 307,200 bytes (1); ÷ 1024 = 300 KB (1).

2. (i) How many colours does 16-bit colour give? (1 mark)
(ii) What is the minimum colour depth for 1000 colours? (1 mark) *(2 marks)*

> (i) 2^{16} = 65,536 (1). (ii) 10 bits, because 2^{10} = 1,024 ≥ 1000 but 2^{9} = 512 is too few (1).

3. Give two differences between raster and vector graphics, with one file format of each. (4 marks) *(4 marks)*

> Raster is made of pixels, vector of shapes (1); raster pixelates when enlarged, vector stays sharp (1); raster e.g. JPEG/PNG (1); vector e.g. SVG/AI (1).

4. Kamala must send a class photo by WhatsApp and also print a logo on a large banner. Which format suits each? Explain. (4 marks) *(4 marks)*

> Photo: JPEG (1) – lossy, small file, quick to send (1). Logo: SVG / vector (1) – enlarges without becoming blocky (1).

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5. List four steps to make a Science Day poster in GIMP using layers. (4 marks) *(4 marks)*

> Open/import the photo and crop or resize it (1); add the logo as a new layer (1); add a text layer with the title and effects (1); save as .xcf and export as PNG/JPEG (1).

Summary

- Multimedia = text, images, audio, video, animation; interactive if the user controls it.
- Pixel = smallest square; size = width × height in pixels.
- Resolution = PPI (screen) or DPI (print); inches = pixels ÷ PPI.
- Colour depth n bits → 2^n colours; 24-bit = true colour (RGB).
- File size = w × h × bits ÷ 8 bytes; ÷ 1024 = KB; ÷ 1024 = MB.
- Lossy = JPEG; lossless = PNG, GIF, TIFF; BMP uncompressed.
- Raster = pixels (GIMP, Photoshop); vector = shapes (SVG, Inkscape).
- Use layers, crop, resize, text; credit images and label AI images.

MCQ answer key – 4.1

1. **A** – A keyboard is a device, not a media element.
2. **C** – A pixel is one coloured square.
3. **C** – 4000 × 3000 = 12,000,000 pixels.
4. **A** – $2^8 = 256$.
5. **B** – $2^6 = 64$.
6. **D** – $2^1 = 2$.
7. **C** – 1024 × 768 × 24 ÷ 8 = 2,359,296 bytes = 2.25 MB.
8. **B** – 1800 ÷ 300 = 6; 1200 ÷ 300 = 4.
9. **A** – JPEG removes some detail to make small files.
10. **C** – PNG is lossless and supports transparency.
11. **D** – SVG stores shapes, not pixels.
12. **A** – The pixels become visible squares.
13. **B** – Inkscape edits SVG vector graphics.
14. **D** – Crop keeps only the part you need.
15. **B** – Most images are copyright; use Creative Commons and credit.

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