EdSutra

Teaching guide

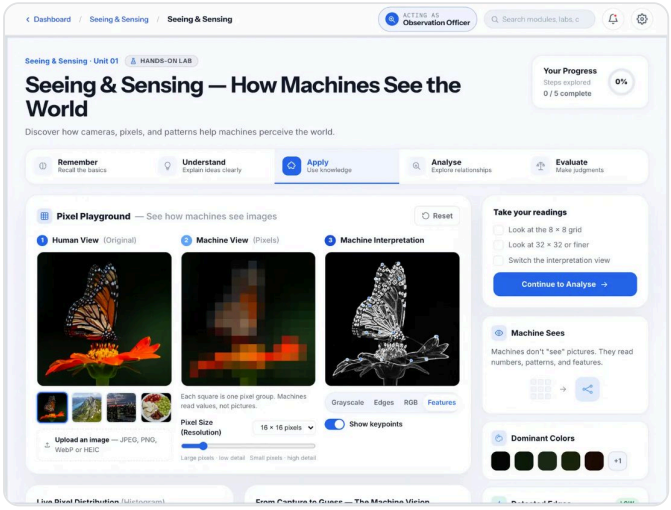
Module 02 · Seeing & Sensing · Unit 01 · Stage 2, Capabilities

Seeing & Sensing

How Machines See the World

Grades 6–10 | 35 minutes | Role: **Observation Officer**

Grade 6: About age 11–12 · Year 7 in the UK · Class 6 in India



The big idea

A camera does not see a butterfly. It stores a grid of numbers: red, green and blue values for every pixel. A vision system finds edges and patterns in those numbers, and a trained model guesses from them. Each step keeps some information and loses some, so the way an image is stored changes what a machine can tell.

The learner's job

Learners are the **Observation Officer** at Cape Marrow Observation Station. Every instrument here turns the world into numbers. Numbers lose things. Their task: say what each instrument really sees. Say where it is blind.

By the end, learners can say

- I can explain how images are stored as arrays of numbers
- I can describe the three stages of a computer vision pipeline
- I can identify real-world applications across medicine, transport, and entertainment
- I can understand why lighting, angle, and resolution affect model accuracy

Before class

- One computer or tablet for each learner or pair, with EdSutra open (this Module is part of the full EdSutra studio).
- Open the studio once on each device before class, so the Unit still runs if the internet drops.
- Play the Remember and Understand steps yourself, so you know where learners will click.
- Optional: save a classroom photo on each device. In Apply, learners can upload it and compare it with the butterfly.
- Best after What is AI? and How Machines Learn.
- Units open in order, and Module 1 comes first. To start a class here, switch on Open every Unit in Settings → Teachers & parents.

Words to introduce

Pixel: One tiny square of an image, stored as a few numbers.

RGB: Three numbers per pixel: how much red, green and blue light, 0 to 255.

Resolution: How many pixels make up a picture. Fewer pixels keep less detail.

Edge: A place where brightness changes sharply, such as an outline.

Edge density: The share of pixels where brightness changes sharply.

Feature: A clue measured from the pixels, such as edges or main colors.

Inference: The guess a trained model makes from the features.

Running the lesson 35 minutes

Open 5 min

"A camera turns a butterfly into numbers. What could get lost on the way, and would the machine ever tell us?"

Before anyone clicks, ask: if a butterfly photo were shrunk to an 8 × 8 grid of squares, what would still be there: colors, outlines or small shapes? Write the guesses on the board and come back to them in Analyze.

Step	What learners do	Ask the class	Listen for
1. Remember 4 min	Read the five big ideas, from "Cameras capture light" to how features lead to a guess. Then click the map of places machine vision shows up, such as medical scans and face unlock.	• What does a camera sensor turn light into? • Which use of machine vision on the map have you met yourself?	A camera stores numbers for each spot of light, not a picture of objects.
2. Understand 6 min	Follow one photo through the four-stage pipeline: real world, pixels, features (edges), interpretation. Then answer two quick checks: what one pixel stores, and what comes after finding edges.	• What does one pixel store? • Why does a bad measurement early on lead to a bad guess later?	A pixel is just red, green and blue numbers. The label comes last, built from the features before it.
3. Apply 8 min	In the Pixel Playground, drop the grid to 8 × 8, raise it to 32 × 32 or finer, and switch the interpretation view (Grayscale, Edges, RGB, Features). They can also upload a photo.	• What disappeared first as the grid got coarser? • What does the Edges view keep, and what does it drop?	A coarse grid keeps rough colors but loses outlines. The Edges view keeps outlines but drops color.
4. Analyze 6 min	Read the live measurements for their image (main colors, edge density, pixels analyzed) and answer two questions: what edge density measures, and what an 8 × 8 version could still give a machine.	• Edge density is not confidence. What is it actually counting? • Look back at our guesses on the board. Were we right about 8 × 8?	Edge density counts sharp changes in brightness. At 8 × 8, rough colors and where they sit survive; outlines are lost.
5. Evaluate 6 min	Compare four ways to show the butterfly (RGB, Grayscale, Edges, Features) in a table. Choose which best helps a machine detect it, then pick the reason that backs that verdict.	• Which view did you choose, and what trade-off does your reason weigh? • Why is "the original photo is always best" refused?	A verdict backed by a trade-off: more information is not always better, and the best view depends on the task.

Steps follow Bloom's revised taxonomy, in the order the Unit presents them.

Deepen the thinking

Critical thinking	A security camera stores a tiny, blurry picture. What could someone wrongly conclude from it, and what would you want to check?
AI thinking	If you built a machine to sort ripe fruit from unripe fruit, which view would you give it: RGB, Edges or Features? Why?
Ethics and fairness	Lighting, angle and resolution change what a camera records. Who could be treated unfairly if face unlock works worse in poor light?
Connect to life	When has a photo search, filter or face unlock got something wrong for you? Which part of the pipeline might have failed?

Misconceptions to listen for

"A computer sees a picture the way I do."

The Machine View and the Live Pixel Distribution chart show what it really has: rows of red, green and blue numbers. Labels only come later, from a model.

"A label like "butterfly" means the machine saw one."

The pipeline separates capture, pixels, features and the guess. A label is an inference built from measurements, so bad measurements mean bad guesses.

"More resolution is always better."

Evaluate refuses "the original photo is always best". Extra detail can bury the outline a detector needs; the right view depends on the task.

In real life the card learners see at the end of the Unit

- A phone camera stores each photo as millions of pixels: numbers for how red, green and blue each dot is.
- A blurry security-camera picture on the TV news shows how a tiny image keeps rough colors but loses shapes.
- Photo apps that search for "beach" turn pixels into features like edges and colors, then a model guesses.

Try it this week. Squint at a poster until it goes blurry. Which can you still make out: colors, layout or small shapes? Compare it with the Unit's 8 × 8 image.

Watch out for. A label like "cat" isn't the computer seeing a cat. It's a guess built from pixel numbers, and more resolution isn't always better.

Talk about it. When you look at a photo, what do you notice that a computer only stores as numbers?

Exit ticket

1. What three numbers does one pixel store?

   _____

2. What does edge density measure?

   _____

3. Name one thing an 8 × 8 version of a photo keeps, and one thing it loses.

   _____

Going further

The Computer Vision Lab stands right after this Unit on the Module page. A real hand or face tracker runs on the camera, or a labeled demo without one. Learners change its blocks and wires and say where the pipeline finds its features.