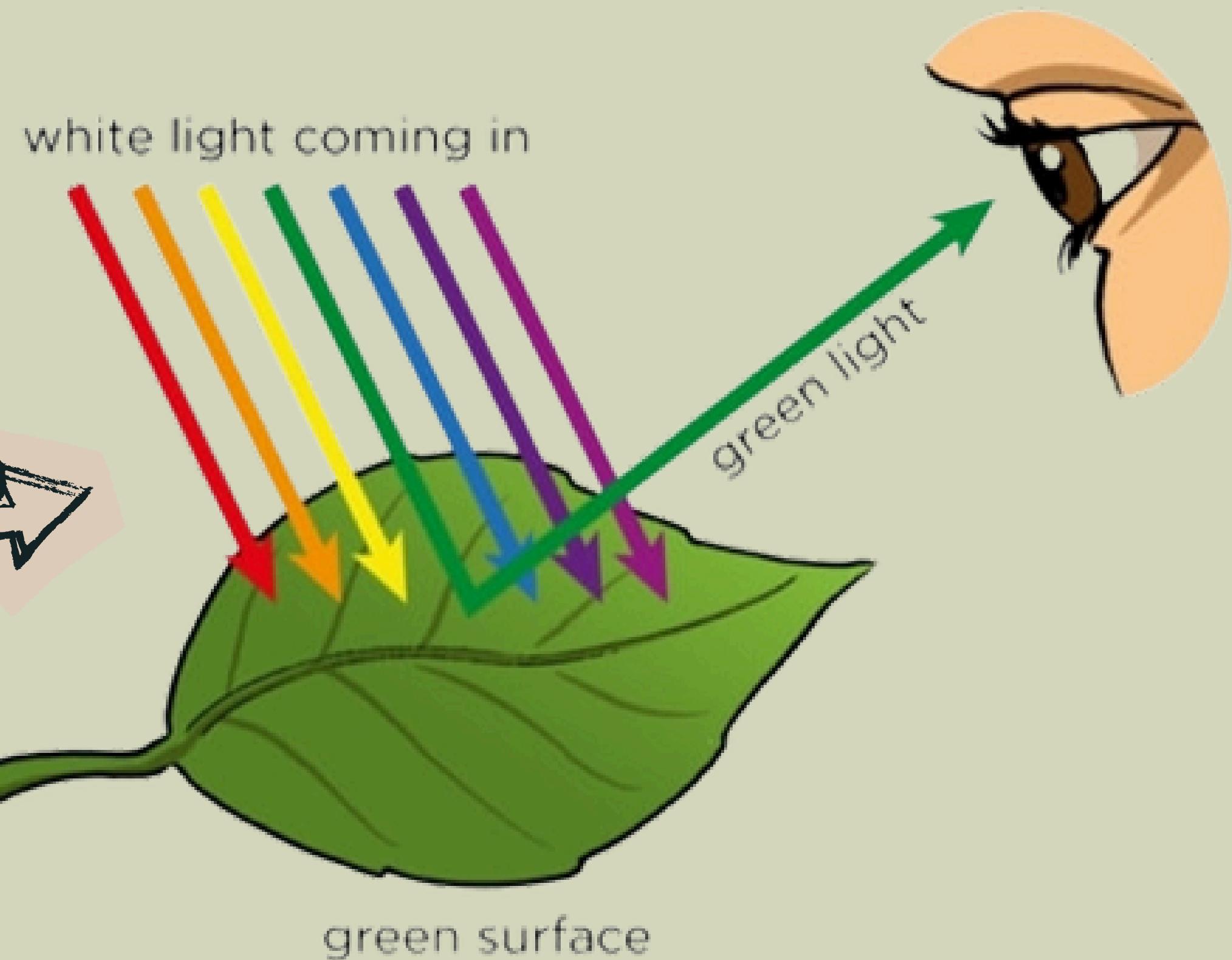


HOW DO WE SEE LIGHT?

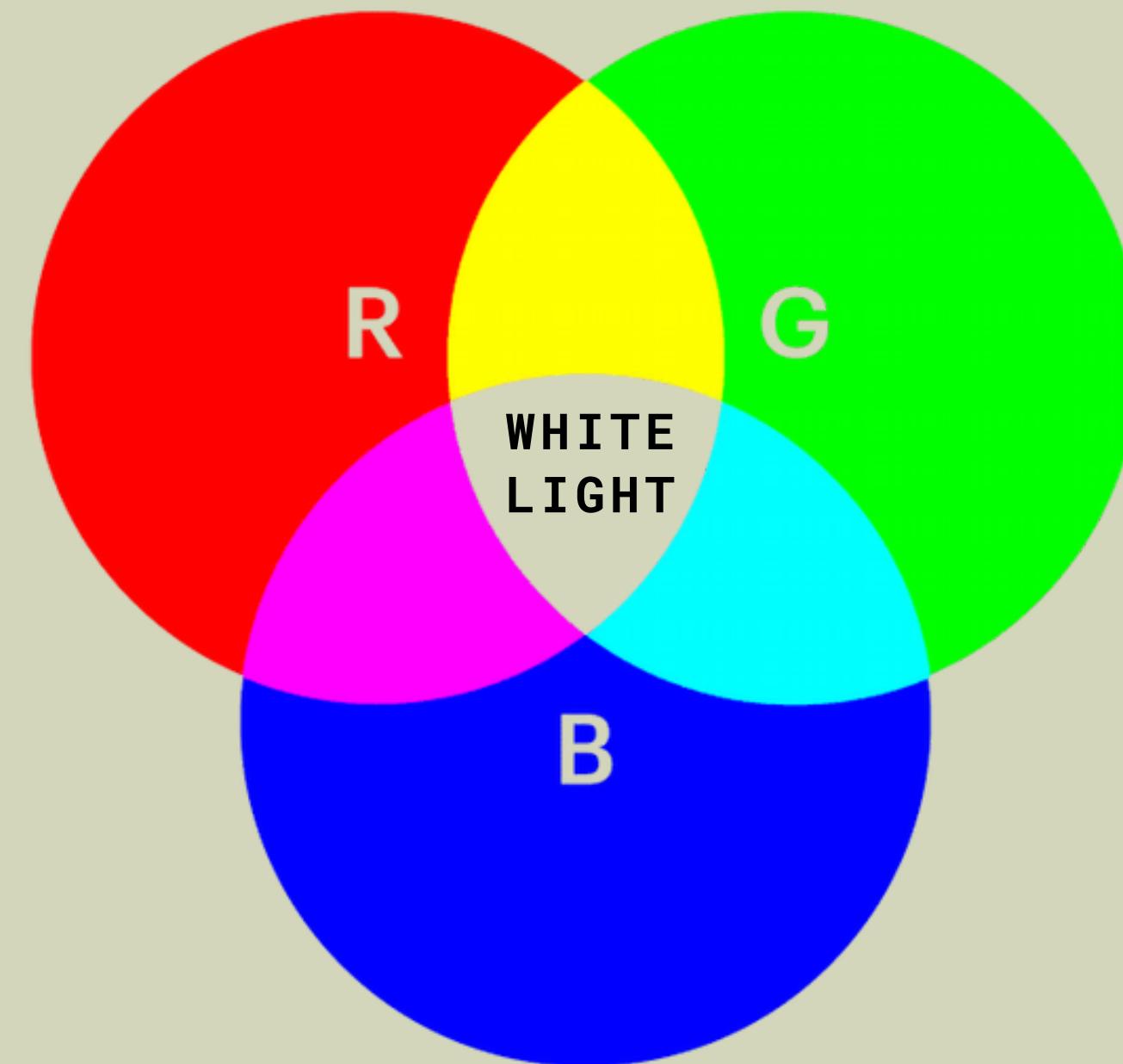
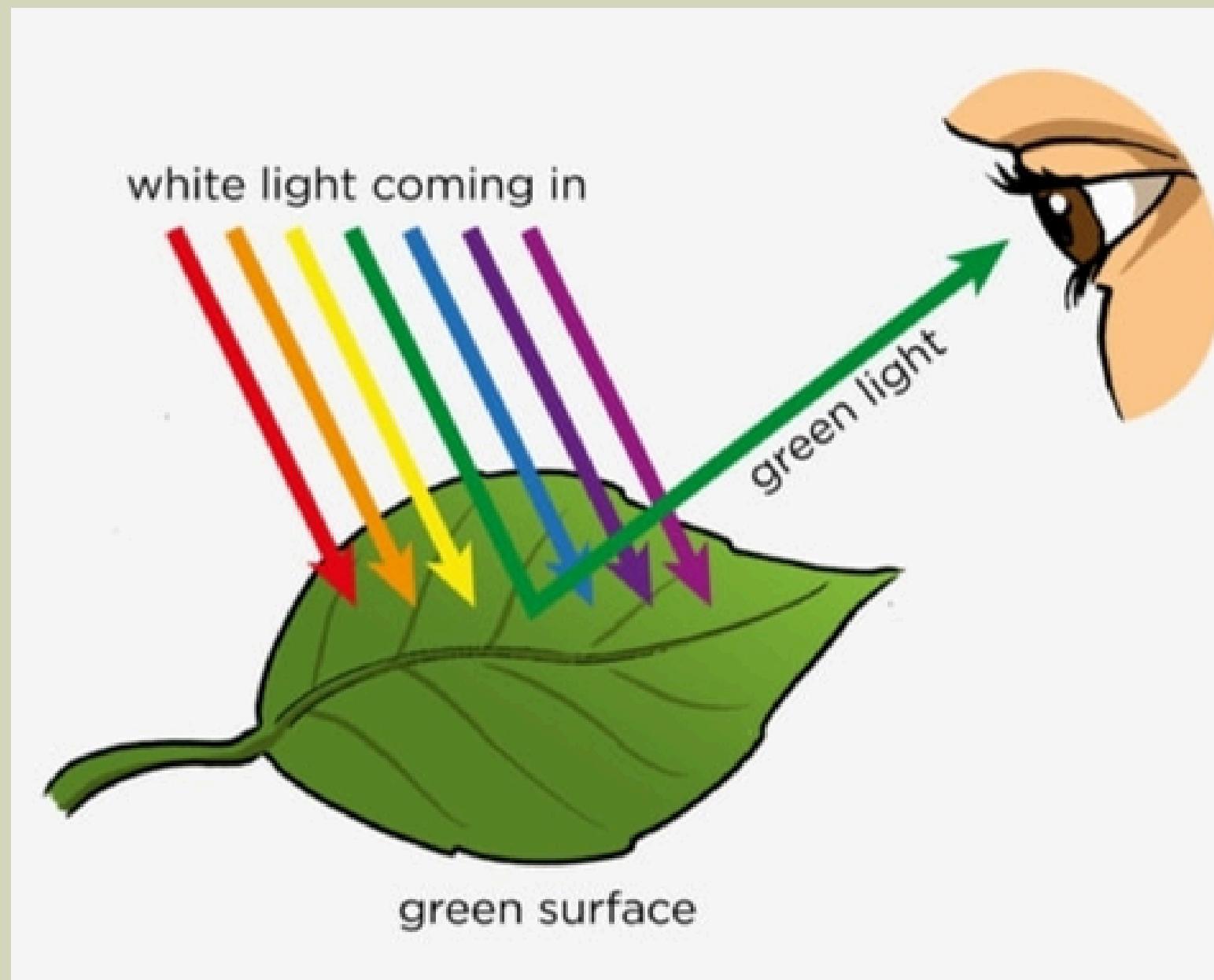


light
shines
and...



HOW DO WE SEE LIGHT?

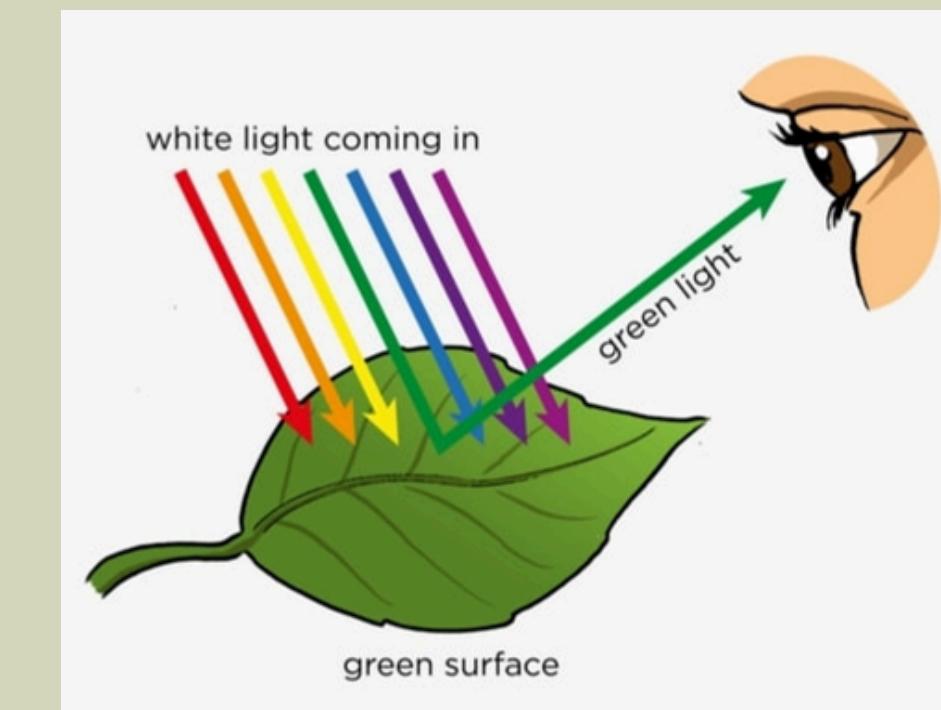
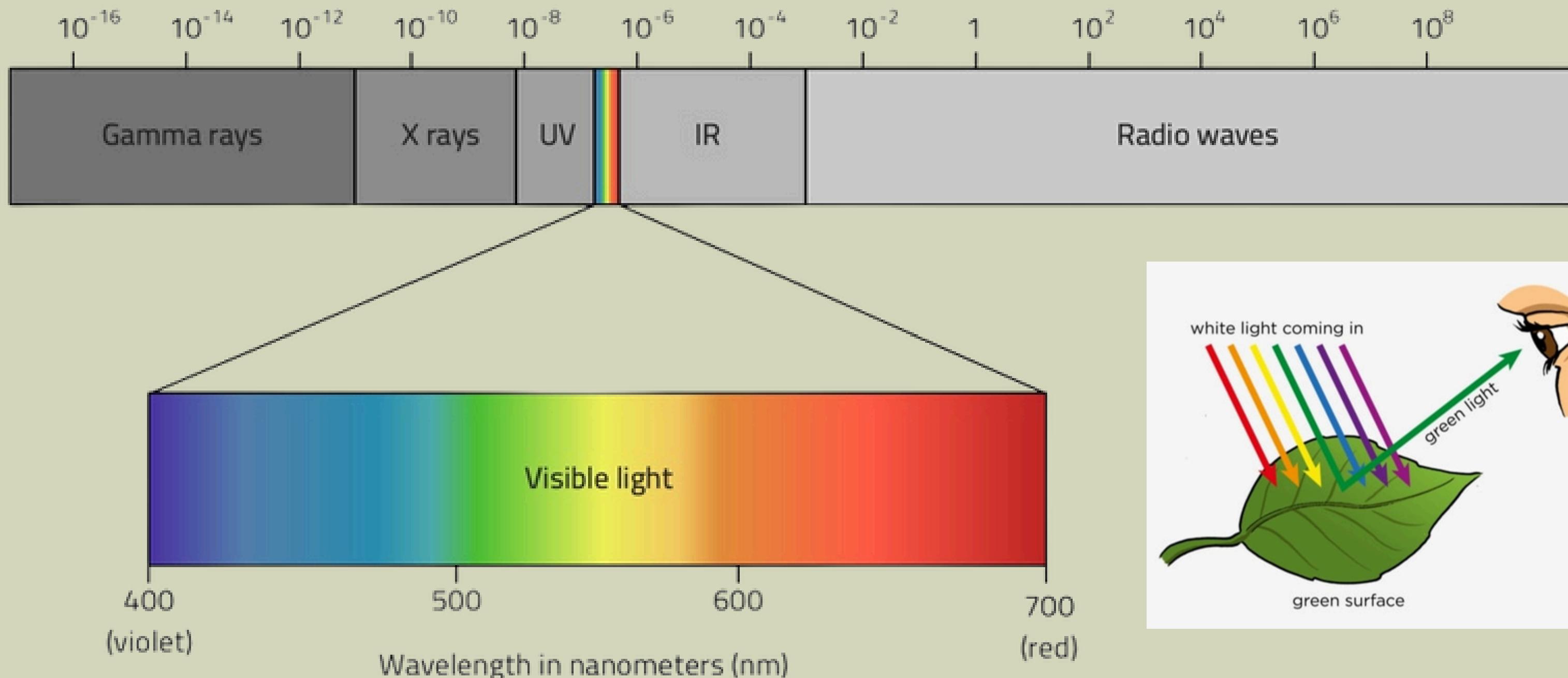
QUICK TUTORIAL



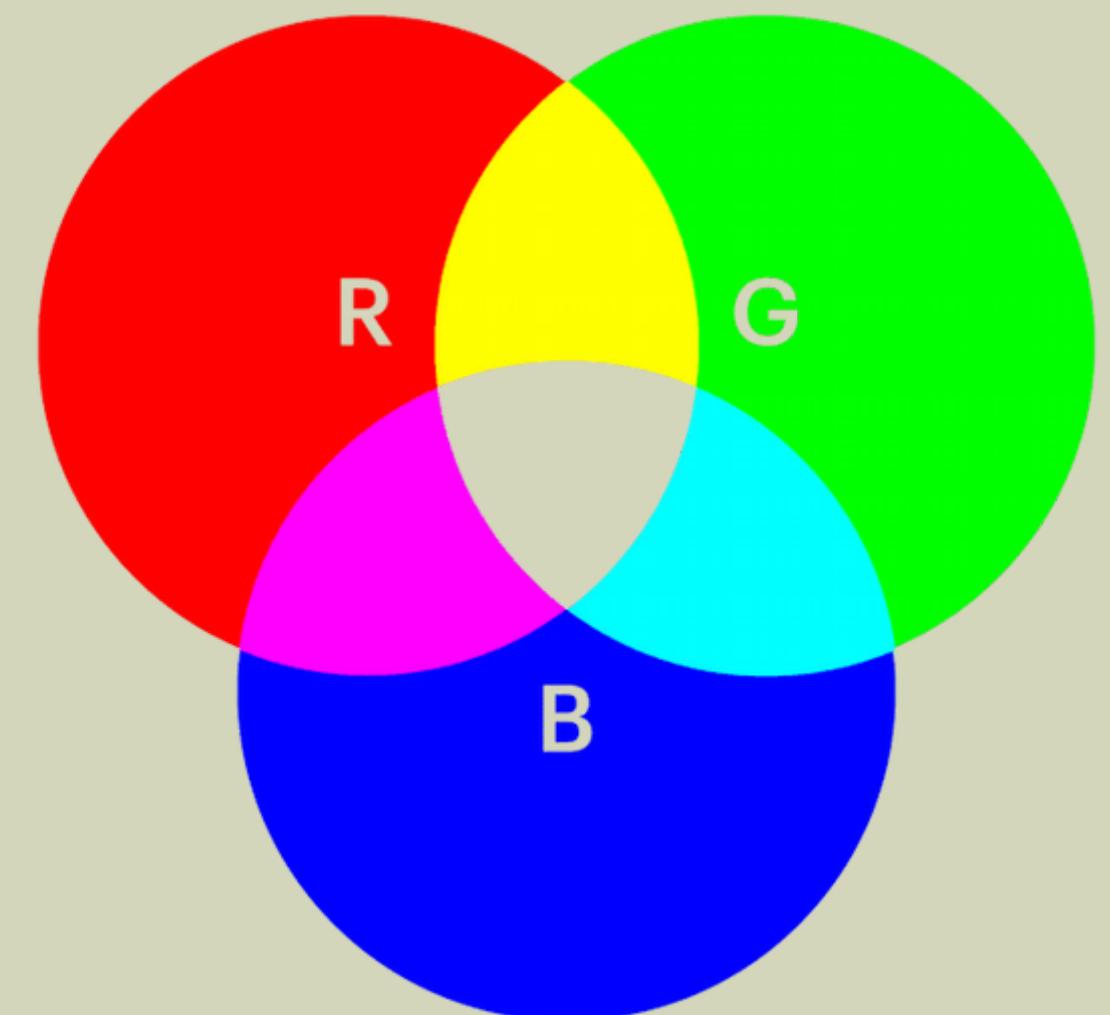
ELECTROMAGNETIC SPECTRUM

00

QUICK TUTORIAL



4 - ELECTROMAGNETIC SPECTRUM



LECTURE #10

Understanding Raster Data



OBJECTIVE

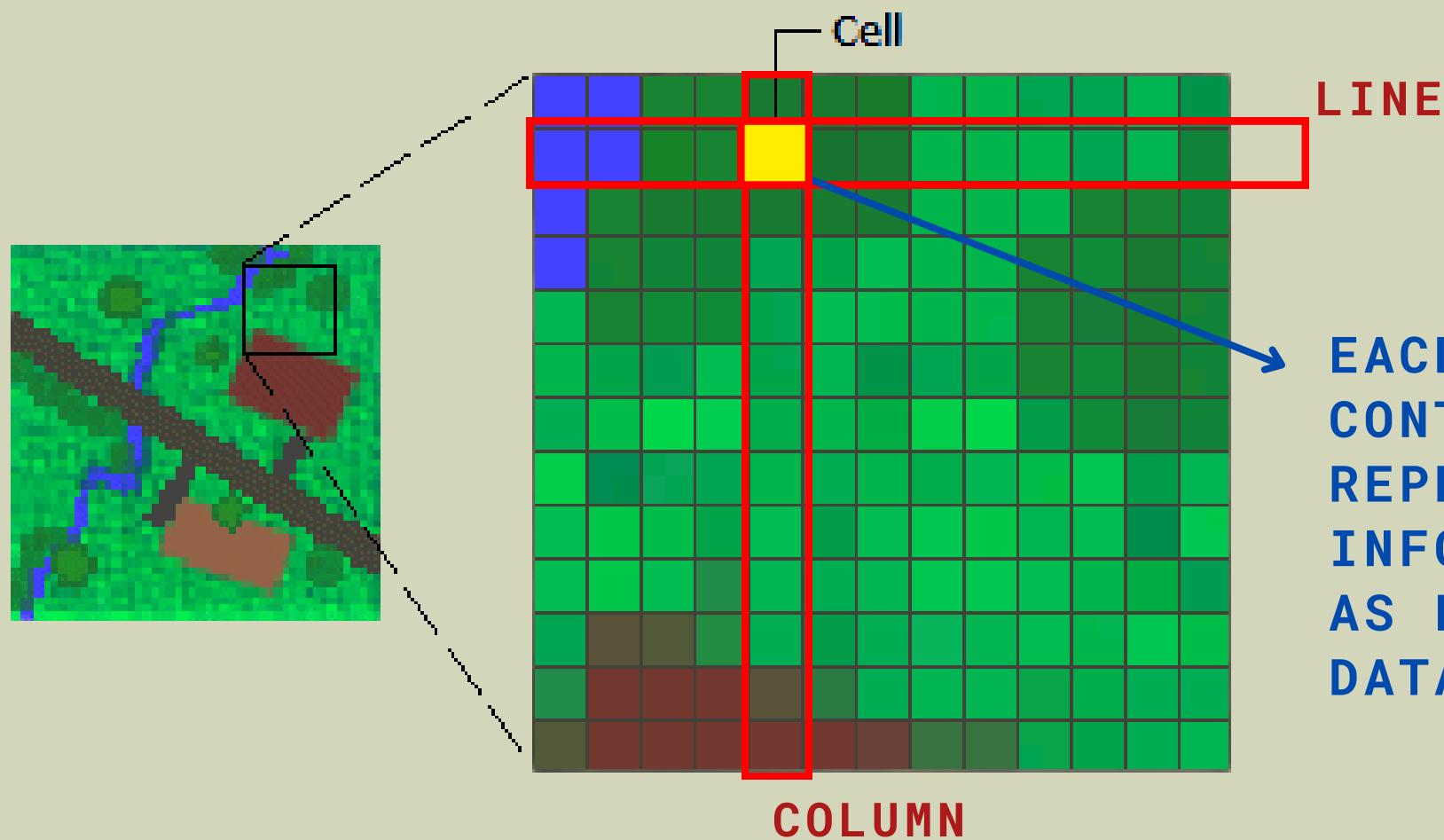
- UNDERSTAND THE BASIC STRUCTURE AND CHARACTERISTICS OF RASTER DATA, LEARN ABOUT SPATIAL RESOLUTION AND SPECTRAL BANDS, AND PRACTICE HOW TO ACCESS AND DOWNLOAD SATELLITE IMAGERY FROM THE COPERNICUS DATA SPACE ECOSYSTEM.

STEPS

1. INTRODUCTION TO RASTER DATA.
2. LEARNING SPATIAL RESOLUTION
3. LEARNING THE ELECTROMAGNETIC SPECTRUM AND SPECTRAL BANDS.
4. DOWNLOAD SENTINEL IMAGES.

1 - WHAT IS A RASTER DATA?

IT'S A **MATRIX OF CELLS** (OR **PIXELS**) ARRANGED AS **ROWS AND COLUMNS**.



IN SOME CASES, YOU HAVE NO CHOICE BUT TO STORE DATA AS A RASTER; FOR EXAMPLE, **IMAGES ARE ONLY AVAILABLE AS RASTERS**.

HOWEVER, MANY **OTHER ELEMENTS** (E.G., POINTS) AND MEASUREMENTS (E.G., PRECIPITATION) **CAN BE STORED AS A RASTER OR FEATURE (VECTOR) DATA TYPE**.

2 – SPATIAL RESOLUTION

SPATIAL RESOLUTION DETERMINES HOW MUCH DETAIL THE RASTER OR SATELLITE IMAGE CAN SHOW.

IS THE REAL-WORLD SIZE OF EACH PIXEL ON THE GROUND.



High Spatial Resolution



Medium Spatial Resolution



Low Spatial Resolution

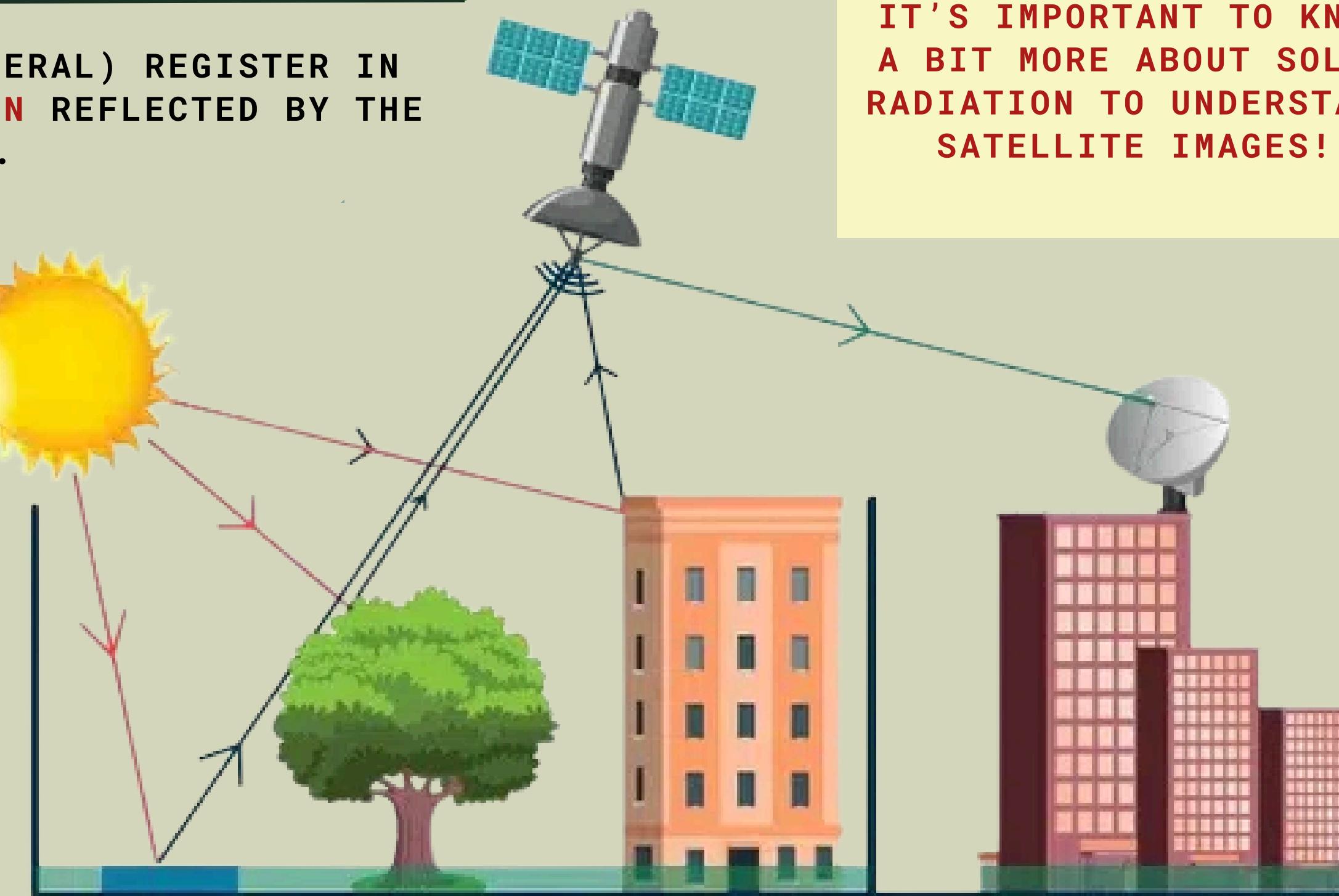
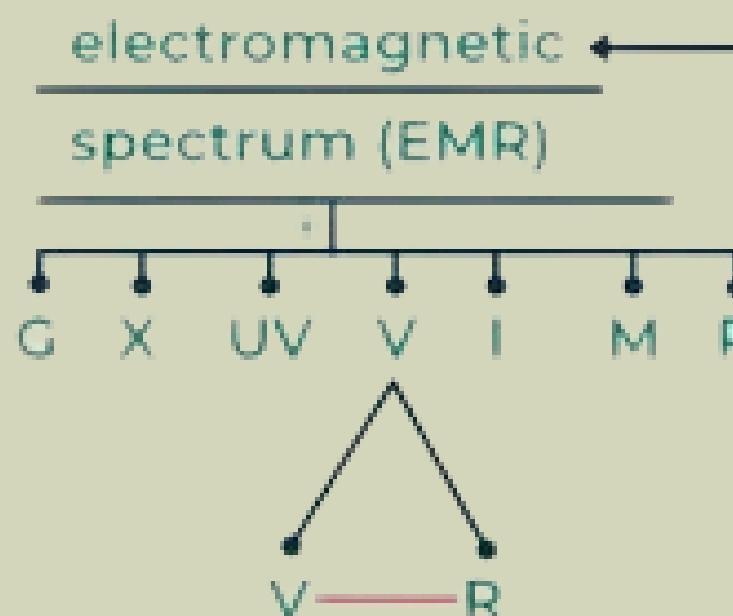
02



3 – SATELLITE IMAGES ARE RASTER DATA

03

SATELITE SENSORS (IN GENERAL) REGISTER IN IMAGES THE **SOLAR RADIATION** REFLECTED BY THE SURFACE.

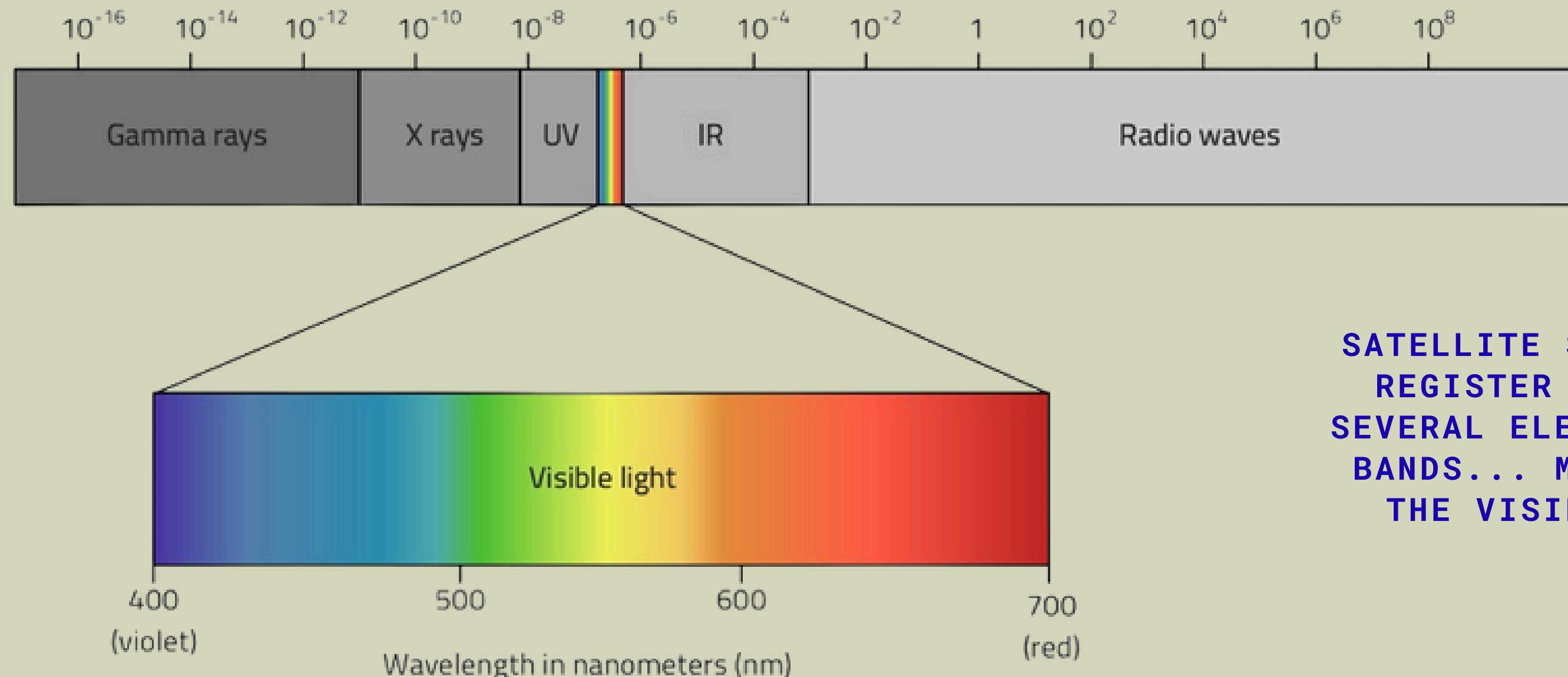


IT'S IMPORTANT TO KNOW A BIT MORE ABOUT SOLAR RADIATION TO UNDERSTAND SATELLITE IMAGES!

4 – ELECTROMAGNETIC SPECTRUM

Electromagnetic Spectrum

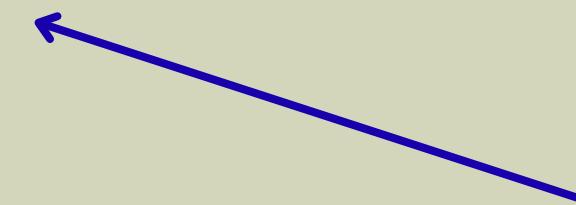
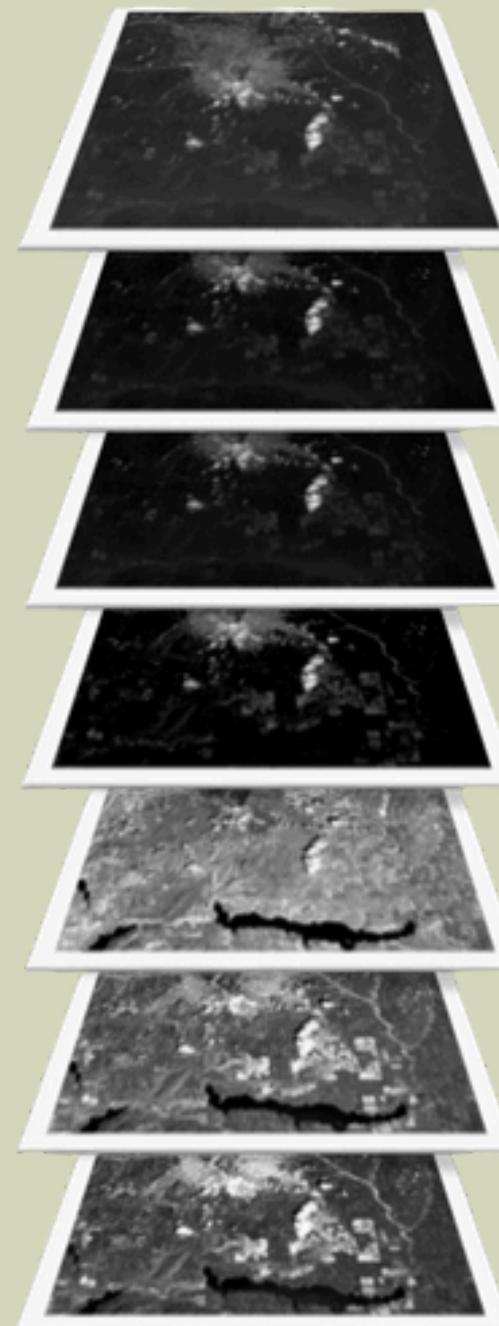
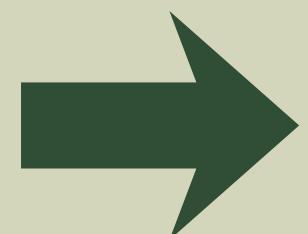
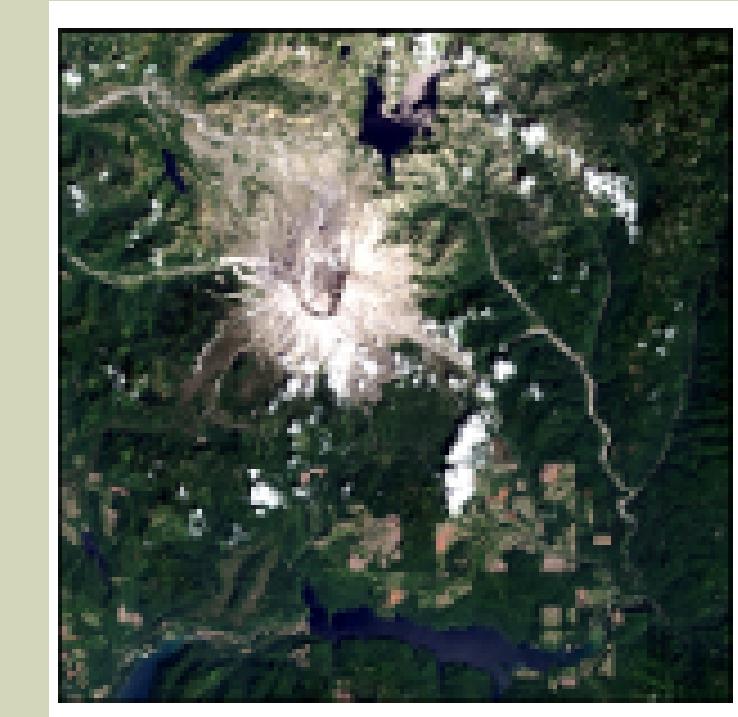
QUICK TUTORIAL



IT'S IMPORTANT TO KNOW
A BIT MORE ABOUT SOLAR
RADIATION TO UNDERSTAND
SATELLITE IMAGES!

SATELLITE SENSORS CAN
REGISTER IMAGES IN
SEVERAL ELECTROMAGNETIC
BANDS... MUCH BEYOND
THE VISIBLE LIGHT

4 – ELECTROMAGNETIC SPECTRUM



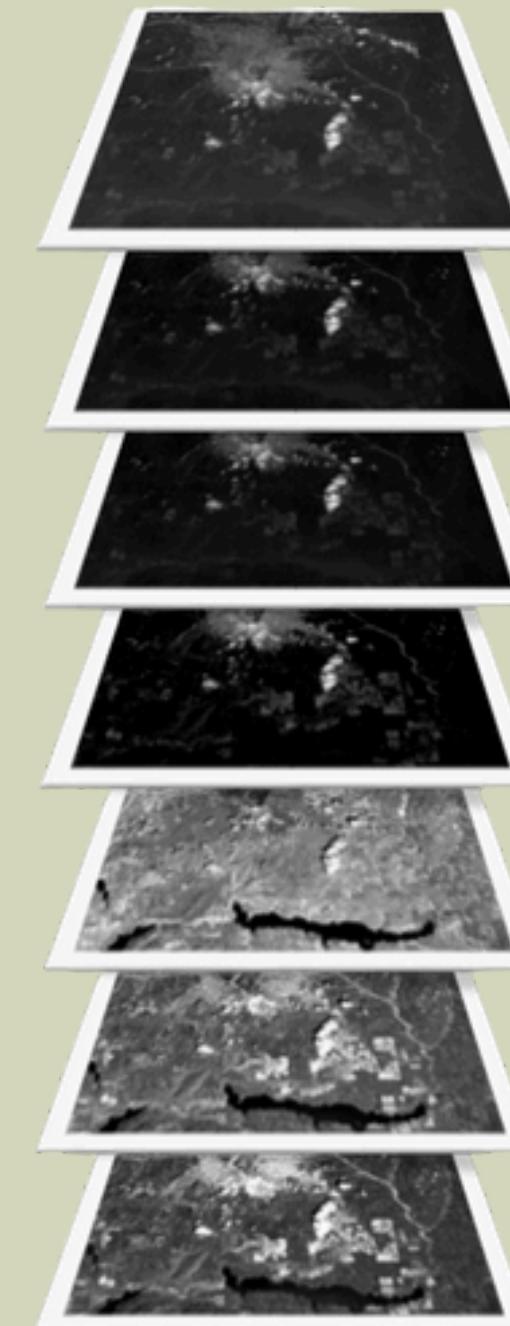
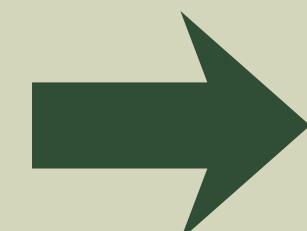
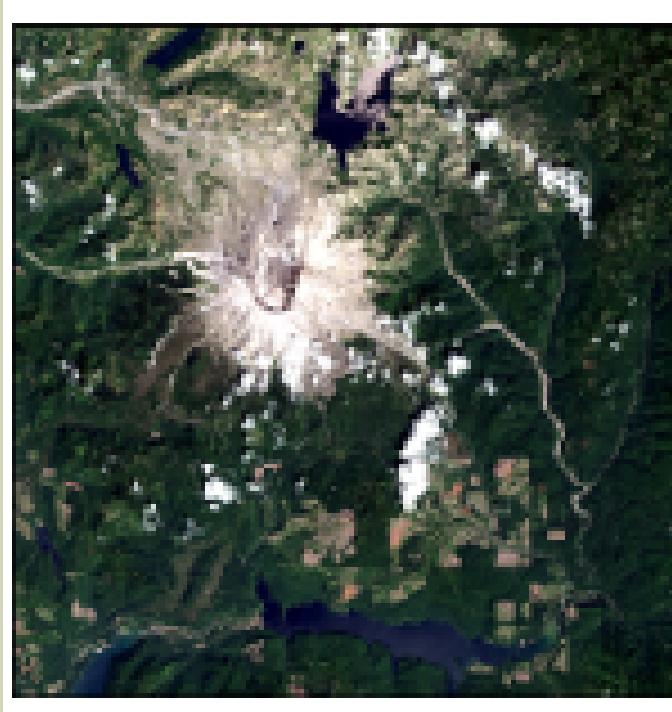
SATELLITE SENSORS CAN
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BANDS... MUCH BEYOND
THE VISIBLE LIGHT

IT'S IMPORTANT TO KNOW
A BIT MORE ABOUT SOLAR
RADIATION TO UNDERSTAND
SATELLITE IMAGES!

4 - ELECTROMAGNETIC SPECTRUM

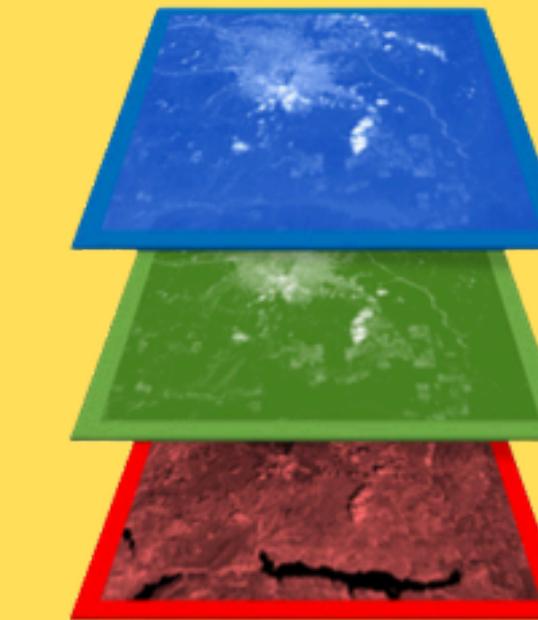
06

QUICK TUTORIAL



A SET OF IMAGES IN DIFFERENT SPECTRAL BANDS ARE REGISTERED AT THE SAME TIME

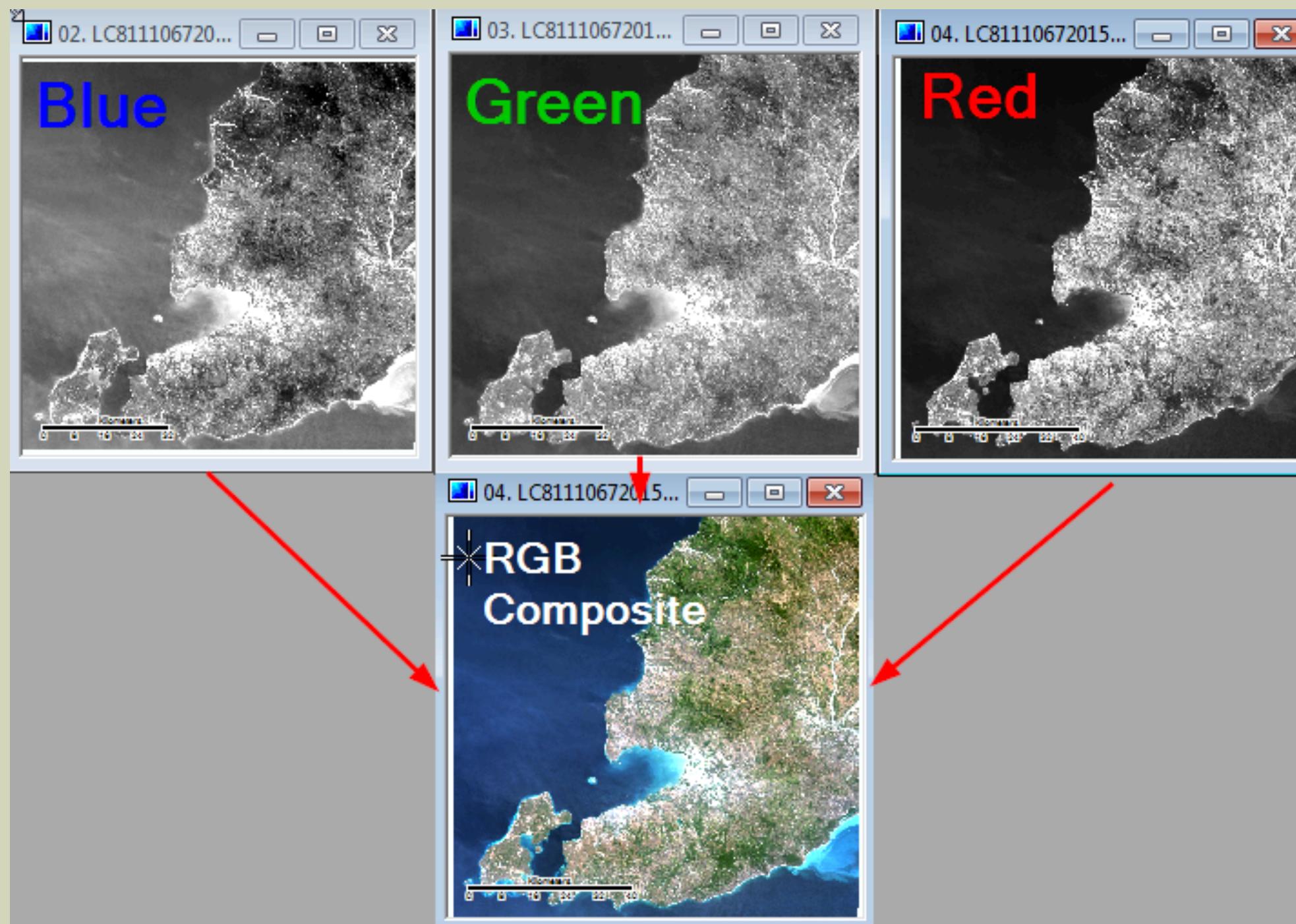
IT CAN ALSO REGISTER SEVERAL BANDS OF THE VISIBLE LIGHT



BUT THEY'RE REPRESENTED IN GRayscale

4 - ELECTROMAGNETIC SPECTRUM

QUICK TUTORIAL



A COLORED SATELLITE IMAGE IS A COMPOSITION OF THREE IMAGES IN DIFFERENT SPECTRAL BANDS (CAPTURED AT THE SAME TIME).

IN COLOR THEORY, RGB (RED, GREEN, BLUE) ARE THE PRIMARY COLORS OF LIGHT: THE BASIS OF HOW SCREENS, CAMERAS, AND SATELLITE SENSORS CAPTURE AND DISPLAY IMAGES.

THIS SYSTEM WORKS THROUGH ADDITIVE COLOR MIXING:
COMBINING RED, GREEN, AND BLUE LIGHT IN DIFFERENT INTENSITIES PRODUCES ALL OTHER COLORS.

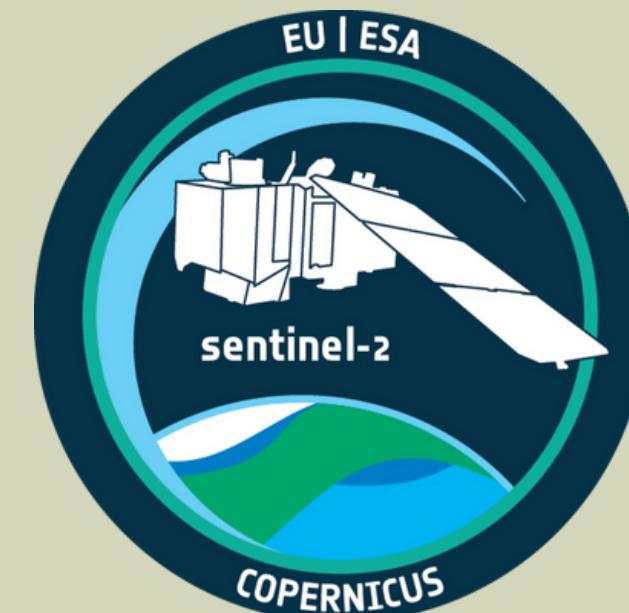
WHEN ALL THREE ARE COMBINED EQUALLY, THEY CREATE WHITE LIGHT.

IN SATELLITE IMAGERY, THE RGB MODEL IS USED TO CREATE NATURAL COLOR COMPOSITES, SHOWING THE EARTH AS IT WOULD APPEAR TO THE HUMAN EYE.

5 – SATELLITE MISSIONS FOR ENVIRONMENTAL ANALYSIS

08

LANDSAT AND SENTINEL ARE THE TWO MOST IMPORTANT AND WIDELY USED SATELLITE MISSIONS FOR ENVIRONMENTAL ANALYSIS.



TOGETHER, THEY FORM THE BACKBONE OF MOST MODERN REMOTE SENSING APPLICATIONS.

LANDSAT OFFERS THE LONGEST CONTINUOUS HISTORICAL RECORD (SINCE 1972).

SENTINEL PROVIDES HIGHER SPATIAL DETAIL AND MORE FREQUENT REVISITS.

6 – LET'S WORK WITH SENTINEL DATA

A) HOW TO DOWNLOAD IMAGES...

- GO TO COPERNICUS DATA SPACE ECOSYSTEM:
 - [HTTPS://DATASPACE.COPERNICUS.EU/](https://dataspace.copernicus.eu/)
- CLICK “[LOGIN](#)” IN THE UPPER RIGHT CORNER.
(IF YOU DON’T HAVE AN ACCOUNT YET, SELECT
“[REGISTER](#)” AND CREATE A FREE ONE).
- OPEN THE DATA BROWSER FROM THE TOP MENU.
 - GO TO “DATA ACCESS → BROWSER”,
 - OR DIRECTLY VISIT
[HTTPS://BROWSER.DATASPACE.COPERNICUS.EU/](https://browser.dataspace.copernicus.eu/)
-

Welcome to Copernicus Data Space Ecosystem

Welcome to the Copernicus Data Space Ecosystem, an open ecosystem that provides free instant access to a wide range of data and services from the Copernicus Sentinel missions and more on our planet’s land, oceans and atmosphere.

The Copernicus Data Space Ecosystem not only ensures the continuity of the open and free access to Copernicus data but also extends the portfolio for data processing and data access possibilities. Delve into the data immediately via the Copernicus Browser or register to create an account and have an even better comprehensive exploration experience.

[Get started](#)

6 - LET'S WORK WITH SENTINEL DATA

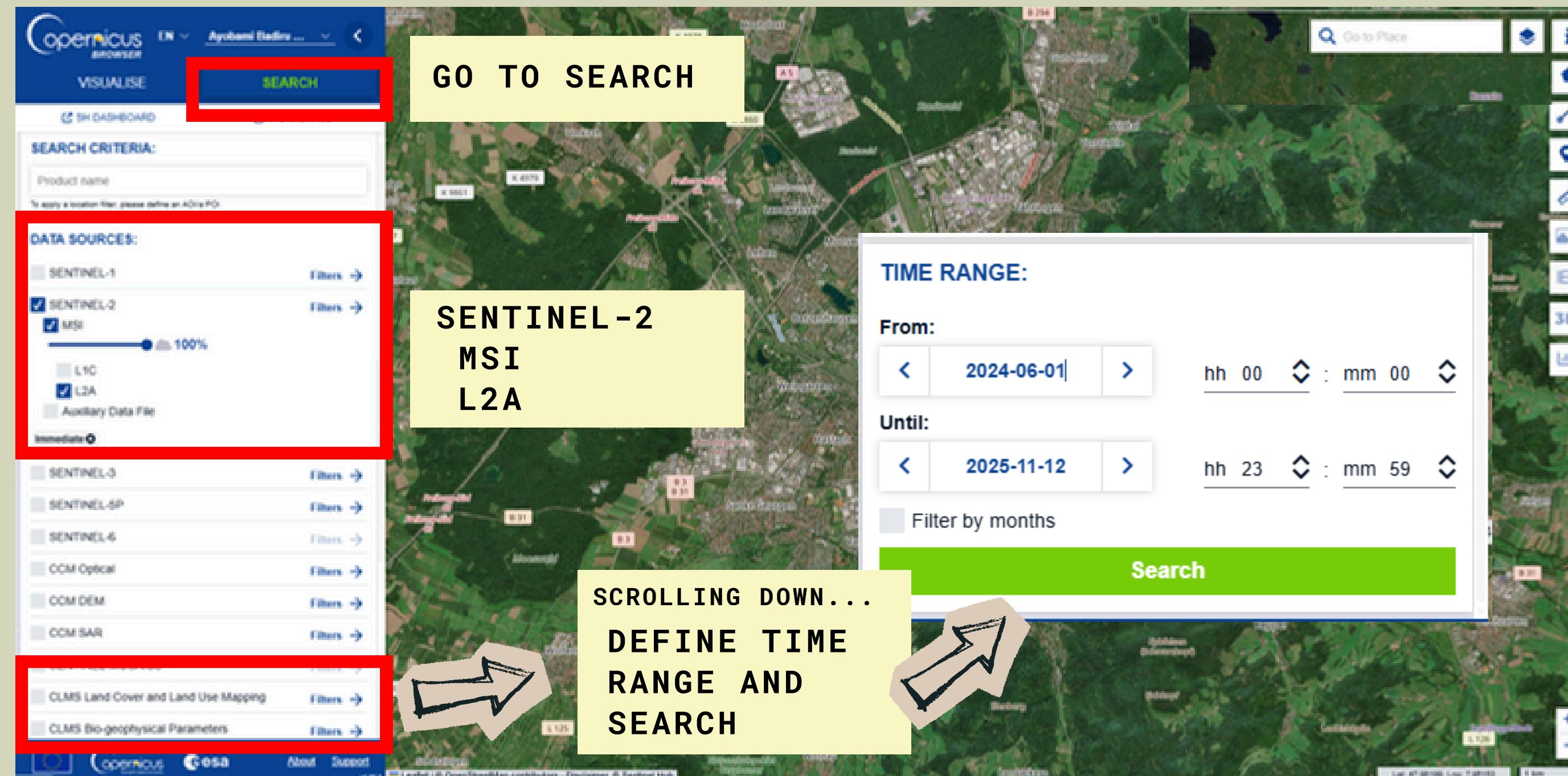
A) HOW TO DOWNLOAD IMAGES...



IN THE MAP SEARCH BAR, TYPE THE NAME OF THE CITY YOU WANT THE IMAGE AND PRESS ENTER.
THE MAP WILL ZOOM INTO THE REGION.

6 – LET'S WORK WITH SENTINEL DATA

A) HOW TO DOWNLOAD IMAGES...



6 - LET'S WORK WITH SENTINEL DATA

A) HOW TO DOWNLOAD IMAGES...

EN Ayobami Badiru ... <

VISUALISE SEARCH

SH DASHBOARD WORKSPACE

< Search Showing 50 results of 262

Select all Add to workspace

Visualise SENTINEL-2 MSI S2MSI2A

S2A_MSIL2A_20251106T103241_N0511_R108_T32UMU_20251106T141402.SAFE
Mission: SENTINEL-2 Instrument: MSI
Sensing time: 2025-11-06T10:32:41.025000Z

Visualize SENTINEL-2 MSI S2MSI2A

S2C_MSIL2A_20251104T103231_N0511_R108_T32ULU_20251104T142114.SAFE
Mission: SENTINEL-2 Instrument: MSI Size: 1021MB
Sensing time: 2025-11-04T10:32:31.025000Z

Visualise SENTINEL-2 MSI S2MSI2A

S2C_MSIL2A_20251104T103231_N0511_R108_T32UMU_20251104T142114.SAFE
Mission: SENTINEL-2 Instrument: MSI Size: 1112MB
Sensing time: 2025-11-04T10:32:31.025000Z

Visualise SENTINEL-2 MSI S2MSI2A

S2B_MSIL2A_20251030T103049_N0511_R108_T32ULU_20251030T130433.SAFE
Mission: SENTINEL-2 Instrument: MSI Size: 1102MB
Sensing time: 2025-10-30T10:30:49.024000Z

Visualise SENTINEL-2 MSI S2MSI2A

S2B_MSIL2A_20251030T103049_N0511_R108_T32UMU_20251030T130433.SAFE
Mission: SENTINEL-2 Instrument: MSI Size: 1114MB
Sensing time: 2025-10-30T10:30:49.024000Z

Visualise SENTINEL-2 MSI S2MSI2A

S2A_MSIL2A_20251027T103151_N0511_R108_T32UMU_20251027T143723.SAFE
Mission: SENTINEL-2 Instrument: MSI Size: 808MB

Load more

SEARCH AND PREVIEW

VISUALIZE...

Opencop Browser EN Ayobami Badiru ... <

VISUALISE SEARCH

SH DASHBOARD WORKSPACE

SEARCH

Show latest date >

Find products for current view

Default

Sentinel-2 L2A

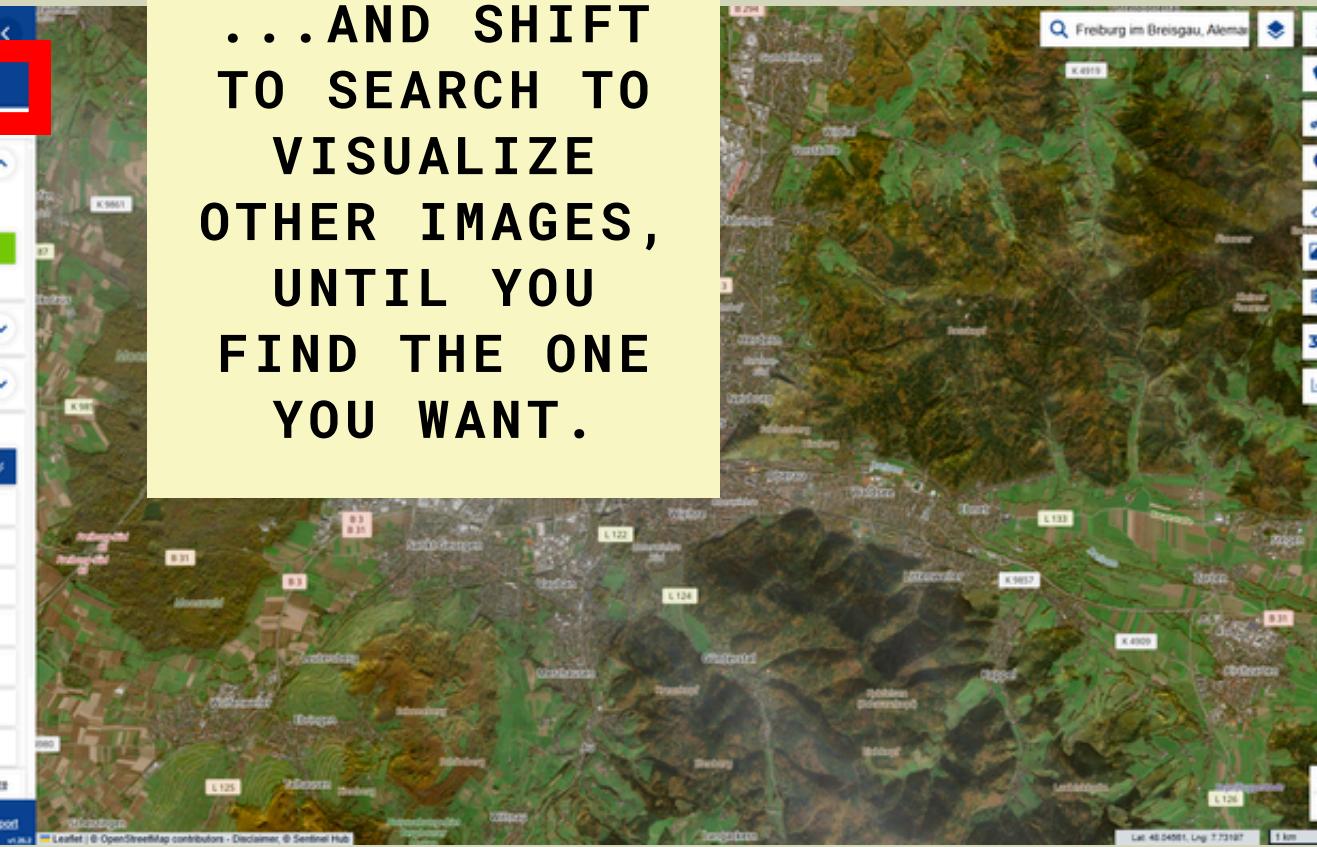
LAYERS:

- True color (Based on bands B4, B3, B2)
- False color (Based on bands B8, B4, B3)
- Highlight Optimized Natural Color (Enhanced natural color visualization)
- NDVI (Based on a combination of bands (B4 - B3)/(B4 + B3))
- False color (urban) (Based on bands B12, B11, B4)
- Moisture index (Based on a combination of bands (B8A - B11)/(B8A + B11))
- SWIR (Based on bands B12, B8A, B4)
- NDWI (Based on a combination of bands (B3 - B8B)/(B3 + B8))

Show effects and advanced colors

Share

...AND SHIFT
TO SEARCH TO
VISUALIZE
OTHER IMAGES,
UNTIL YOU
FIND THE ONE
YOU WANT.



6 – LET'S WORK WITH SENTINEL DATA

A) HOW TO DOWNLOAD IMAGES...



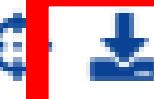
S2C_MSIL2A_20251104T103231_N0511_R108_T32UMU
_20251104T142114.SAFE

Mission: SENTINEL-2 Instrument: MSI Size: 1112MB

Sensing time: 2025-11-04T10:32:31.025000Z

Visualise

SENTINEL-2 MSI S2MSI2A



WHEN YOU FIND THE
IMAGE, DOWNLOAD
HERE.

IT MAY TAKE SOME
MINUTES TO
DOWNLOAD.

6 – LET'S WORK WITH SENTINEL DATA

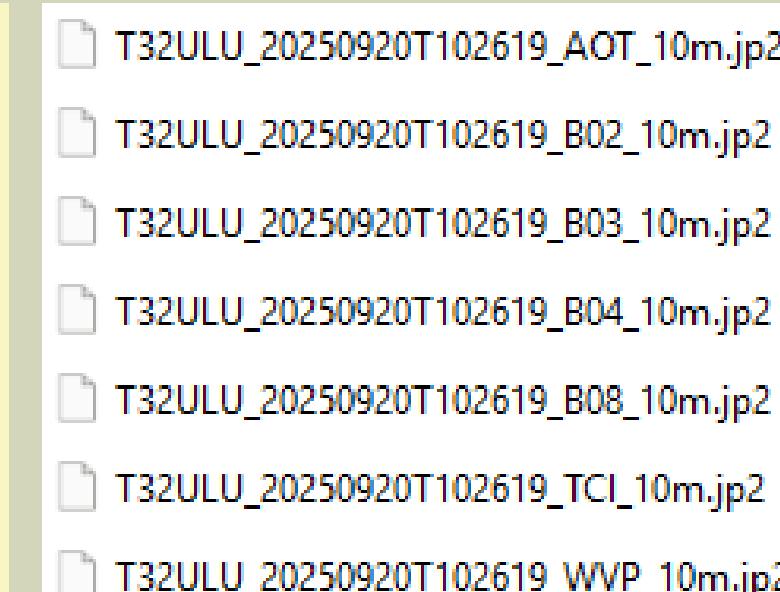
B) CHECKING THE IMAGE



WHEN YOU DOWNLOAD A SENTINEL-2 IMAGE (LEVEL-2A), IT COMES AS A FOLDER ENDING IN .SAFE.

INSIDE IT, THE SPECTRAL BANDS ARE STORED IN SUBFOLDERS LIKE:
GRANULE → IMG_DATA → R10M
(10-METER RESOLUTION).

EACH FILE – FOR EXAMPLE B02, B03, B04, B08 – REPRESENTS A SPECIFIC WAVELENGTH (BLUE, GREEN, RED, AND NEAR-INFRARED).



File name	Band	Description
B02_10m.jp2	Band 2 (Blue)	Captures blue light (~490 nm)
B03_10m.jp2	Band 3 (Green)	Captures green light (~560 nm)
B04_10m.jp2	Band 4 (Red)	Captures red light (~665 nm)
B08_10m.jp2	Band 8 (NIR)	Near-infrared (~842 nm)
TCI_10m.jp2	True Color Image	Pre-made RGB composite
AOT_10m.jp2	Aerosol Optical Thickness	Atmospheric correction info
WVP_10m.jp2	Water Vapor	Atmospheric water content

LECTURE #10

Understanding Raster Data



REVIEW QUESTIONS

1. WHAT IS RASTER DATA AND HOW IS IT DIFFERENT FROM VECTOR DATA?
2. WHAT DOES THE TERM SPATIAL RESOLUTION MEAN IN A SATELLITE IMAGE?
3. HOW DO SPECTRAL BANDS HELP US ANALYZE THE EARTH'S SURFACE?
4. WHICH BANDS ARE USED TO CREATE A TRUE COLOR IMAGE (RGB)?
5. WHY ARE SENTINEL-2 AND LANDSAT IMPORTANT MISSIONS FOR ENVIRONMENTAL STUDIES?
6. HOW CAN WE ACCESS AND DOWNLOAD FREE SATELLITE IMAGERY FROM COPERNICUS DATA SPACE?
7. WHAT IS THE PURPOSE OF THE .SAFE STRUCTURE IN SENTINEL-2 PRODUCTS?

TO THINK ABOUT...

IF YOU HAD TO EXPLAIN WHAT A RASTER IS TO A FRIEND IN ONE SENTENCE,
HOW WOULD YOU DESCRIBE IT?