D|S|R|G

HMI - introduction

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BASIC NOTIONS: human-system interaction

- HSI – human-system interaction

System (examples):

- Computer
- Road network
- Airport
- Workplace
- Home environment
- Vending machine
- Vehicle
- Course registration process
- Passive, mechanical tools (such as a hammer)

Human – System Interaction

- Human's role in technical systems:
  - How is an individual/group affected by the system
  - How an individual/groups can affect the system
  - How can the designed system be adapted to be used by people

BASIC NOTIONS: human-machine/comp. interaction

- HMI – human-machine interaction (interface)
- HCI – human-computer interaction

Human-computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them.

(Hewett et. al.)

Landmarks: human interaction with technology

- Early stone age
  - Earliest findings from 2.5 million years ago to 40,000 BC – **eoliths**

  Origin is debated:

  a. tools with sharps edges, for digging, chopping, weapons

  b. erosion formed

Selection of Tylor's collection of Harrisonian eoliths in the Pitt-Rivers Museum. Source: E. R. Frank. History & Anthropology. Sep2011, Vol. 22 Issue 3

Landmarks: human interaction with technology

- Middle Stone Age – Lithic technology
  - More precise and varied tools, such as spears and animal traps
  - Most highly developed for the age – cutting and chopping tools such as knives with handles, arrows (made from bones), harpoons (100,000 to 40,000 BC)
  - Migrating and learning to live in caves

Landmarks: human interaction with technology

- Later stone age

(40,000 to 10,000 BC)

- More distinctively shaped tool parts (blades, handles etc.)
- First cave engraver, sculptures

Lascaux cave paintings circa 20,000 BC

Landmarks: human interaction with technology

- Bronze age (up to 3,000 BC) – “mass produce” of cups, vases, weapons, jewelry.
- Iron age (2,000 BC till now)
- Starting from 8,000 BC (end of ice age 10,000 BC) – settled way of life:
  - Fishing
  - Farming
  - Hunting

Landmarks: human interaction with technology

- Introduction of writing – 3,000 BC

in

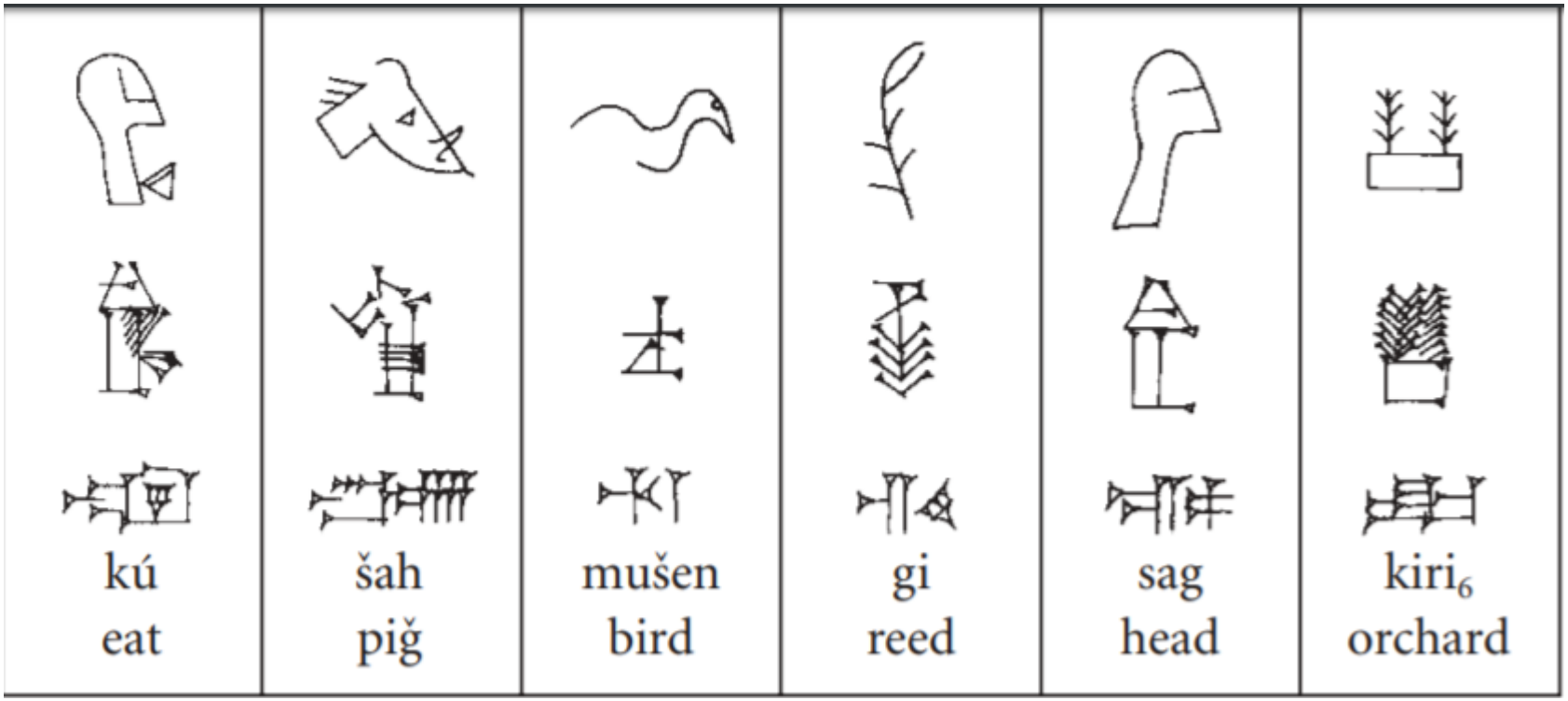
  - Mesopotamia (cuneiform)
  - China

Possibility of communication over place and time

Division of people into classes – “elite” and “workers”

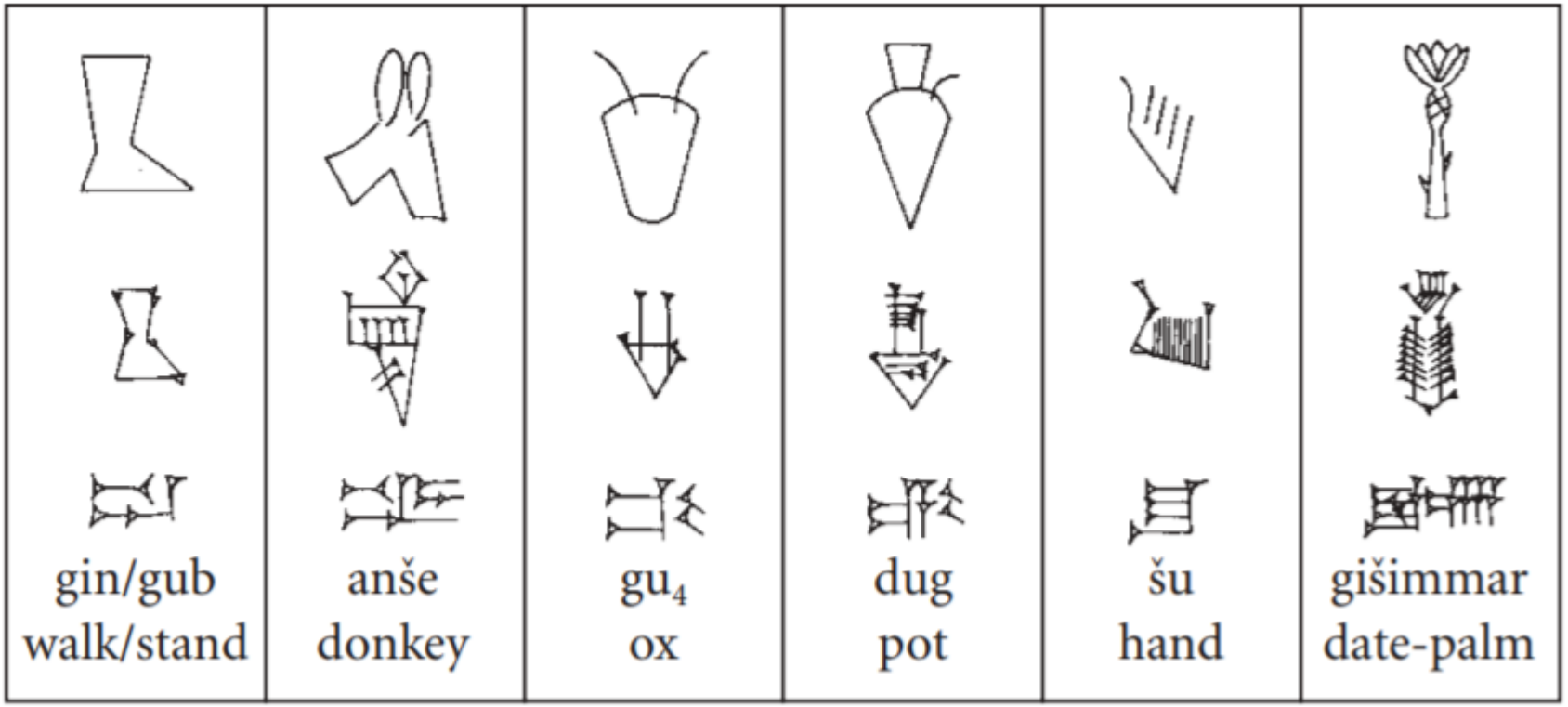
Origin of Lexigraphic Writing in Mesopotamia

protocuneiform



Origin of Lexigraphic Writing in Mesopotamia

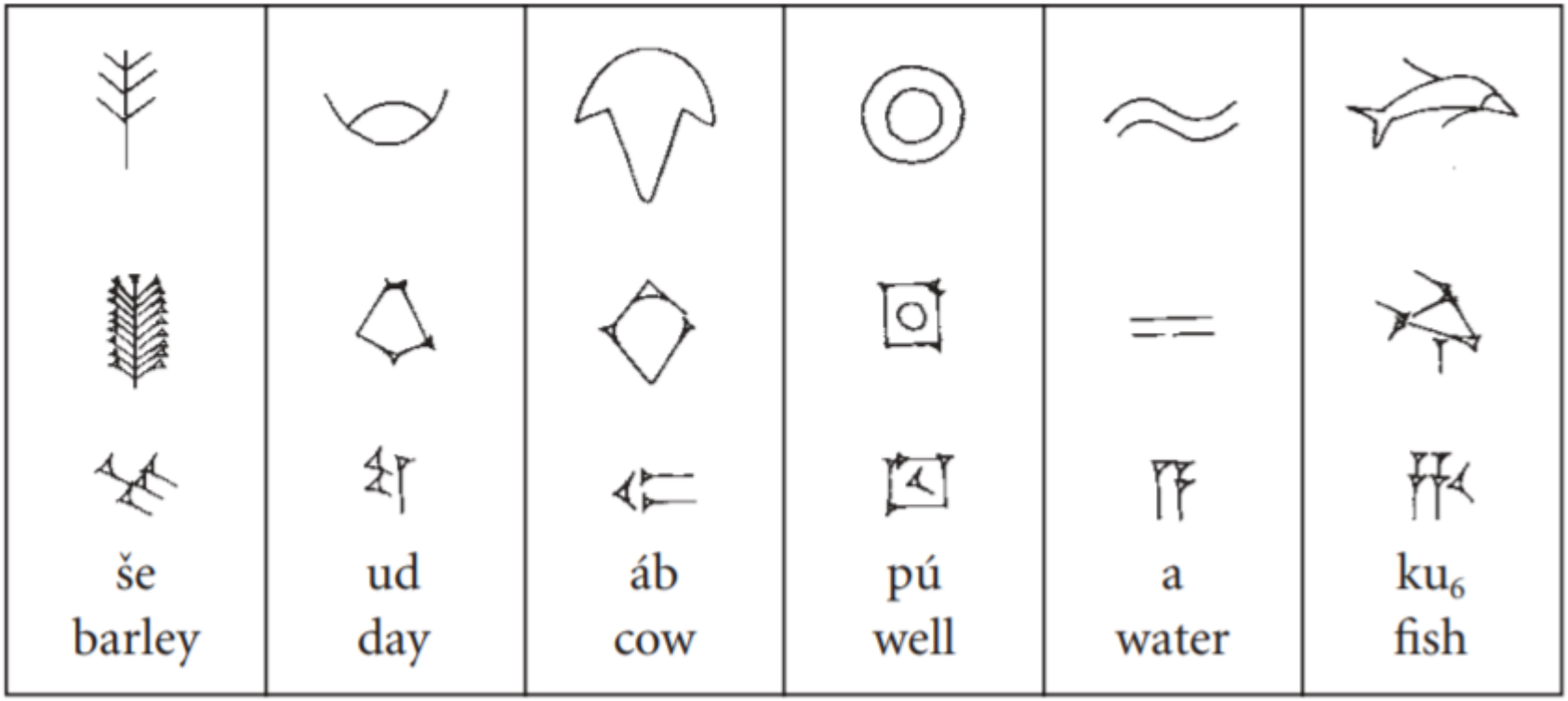
cuneiform



gin/gub walk/stand	anše donkey	gu_4 ox	dug pot	šu hand	gišimmar date-palm

Origin of Lexigraphic Writing in Mesopotamia

Late Assyrian form



Origin of Lexigraphic Writing in Mesopotamia

- Cuneiform signs showing, from top to bottom in each case, first the form in protocuneiform, c.3300 bc; then the form in early cuneiform, c.2400 bc; then the Late Assyrian form, c.650 bc, the signs now turned 90 degrees to the left; then the syllabic value; and finally the meaning. The subscripts (as in gu4) distinguish this sign from other signs that have the same phonetic value (called homophones). (After C.B.F. Walker, 1990, pl. 4, p. 20.)

(Powell, B. B. (2012) Origin of Lexigraphic Writing in Mesopotamia, in Writing: Theory and History of the Technology of Civilization, Wiley-Blackwell, Oxford, UK)

Landmarks: human interaction with technology

1700s

INDUSTRIAL REVOLUTION

- Invention of machines
- Building factories
- Workplaces out of home – migration to towns
- “Working hours”
- Women and children could work with machines
- Change of power source (from wind, man and water - to steam and coal – **development of coal mining**)
- Use of trains for transport of goods

Landmarks: human interaction with technology

- First train by G. Stephensen – 1829

(39 km/h)

Stephenson's *Rocket - a replica*

Landmarks - summary

- Stone – basic material for tool making for almost 2.5 million years
- Last 10,000 of these – bronze and iron
- 3,000 BC – use of wheel
- Gradual but important developments in last 2000 years
- Industrial revolution radically changes everything in 300 years
- Are we undergoing a revolution now?

Human-computer interaction

- Programming languages
  - Machine code
  - Assembly
  - Higher level languages (FORTRAN, Basic, Pascal, C++, Java)

  Same task – different languages

Human-computer interaction

Human-System Interaction
Computers

Task: 22 + 31 + 44

- **Machine code**: 1950/60s

```
140900022    22          in memory location
320900031    + 31
320900044    + 44
440900000    print
990000000    stop
```

Human-computer interaction

Human-System Interaction
Computers

Task: 22 + 31 + 44

- **Assembly**: 1950/60s

```
loadi   22
addi    31
addi    44
print
stop
```

Human-computer interaction

Human-System Interaction
Computers

Uppgift: 22 + 31 + 44

- 1960/70s high-level languages (Pascal, Cobol, Fortran)
- Java 1990s:

```
int n;
n = 22 + 31 + 44;
System.out.println("n = " + n);
```

Interfaces - Computers

- Interface
  - meeting place between user and a program
  - previously difficult
    - cables and cathode tubes
    - machine code
    - text-based
  - now windows-based - mouse for manipulation
    - icons, buttons, scrollbars, menus
    - click, drag and drop
    - WYSIWYG

Cognition

- The concept of **cognition** deals with the processes that allow us to gather and process information:
  - how we receive information from the environment
  - how we process and store informationen
  - reasoning/manipulating knowledge
  - understanding and using language

Cognitive psychology

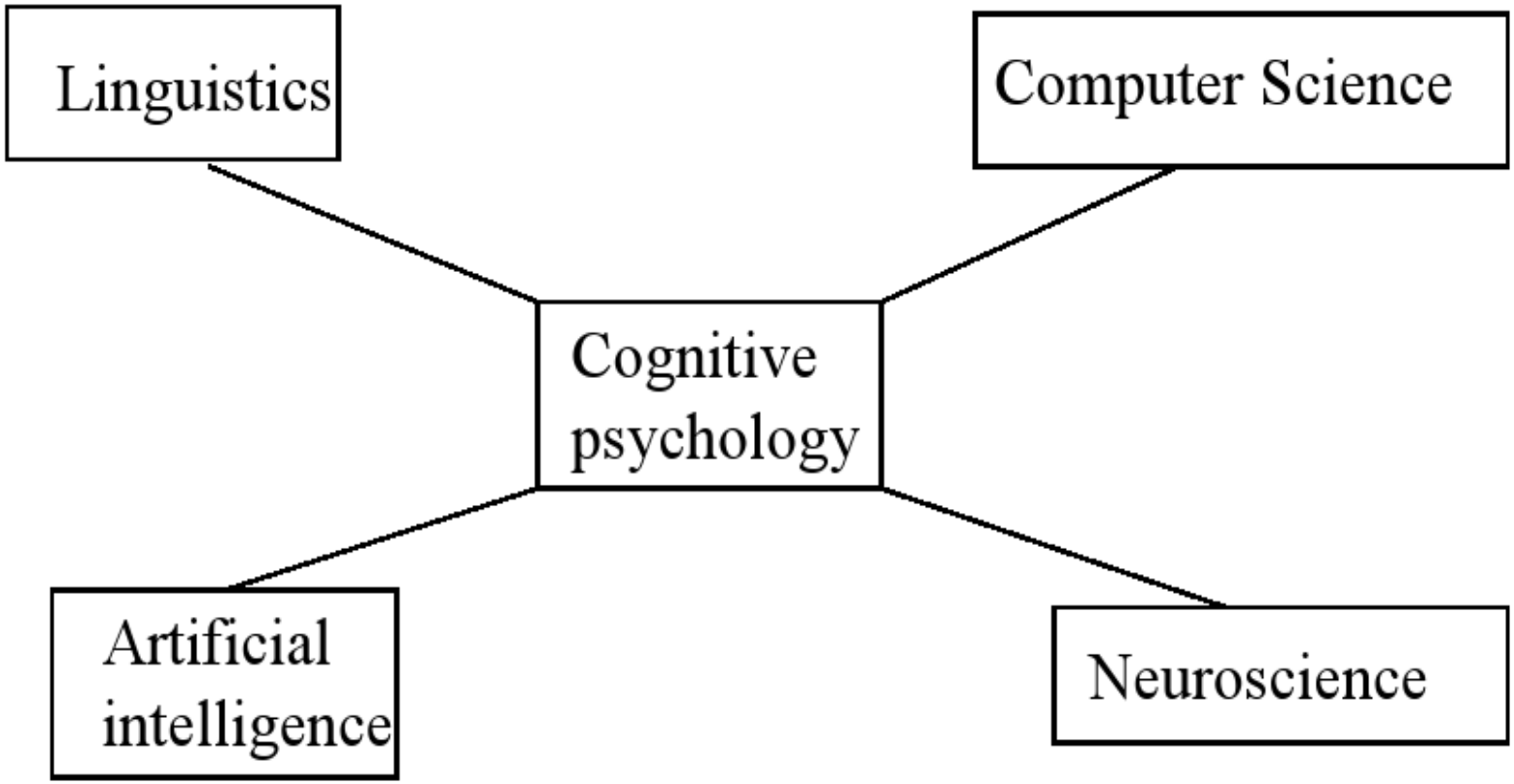
- Lat. *gnoscere* = to know
  cognoscere = to get to know

- *Definition:*
  Cognitive psychology is that branch of psychology that deals with human information processes, ie. the way we
  - gather, process, store and use information

Cognitive psychology and human-system interaction

- Knowledge of cognitive psychology can contribute to better infterfaces with technical systems :
  - what we can expect from the users of the system
  - how we can make the user's task easier to perform
  - identify and explain possible difficulties a user might have to face
  - provide methods that enhance the capacity of the user

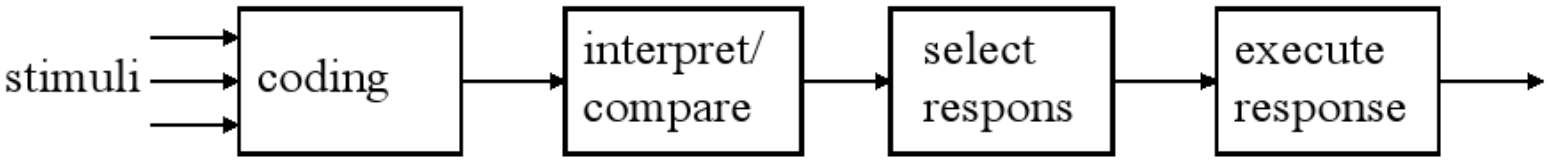
Related areas



Cognitive psychology

- The basic assumption is that cognitive processes can be analyzed as a sequence of smaller steps
- Each step receives input from a previous step, processes it and sends new information to the next step

Data (stimuli) are received by our senses
interpreted (using what is already in memory)
a **response** is selected
the response **is executed** (eg. using language)



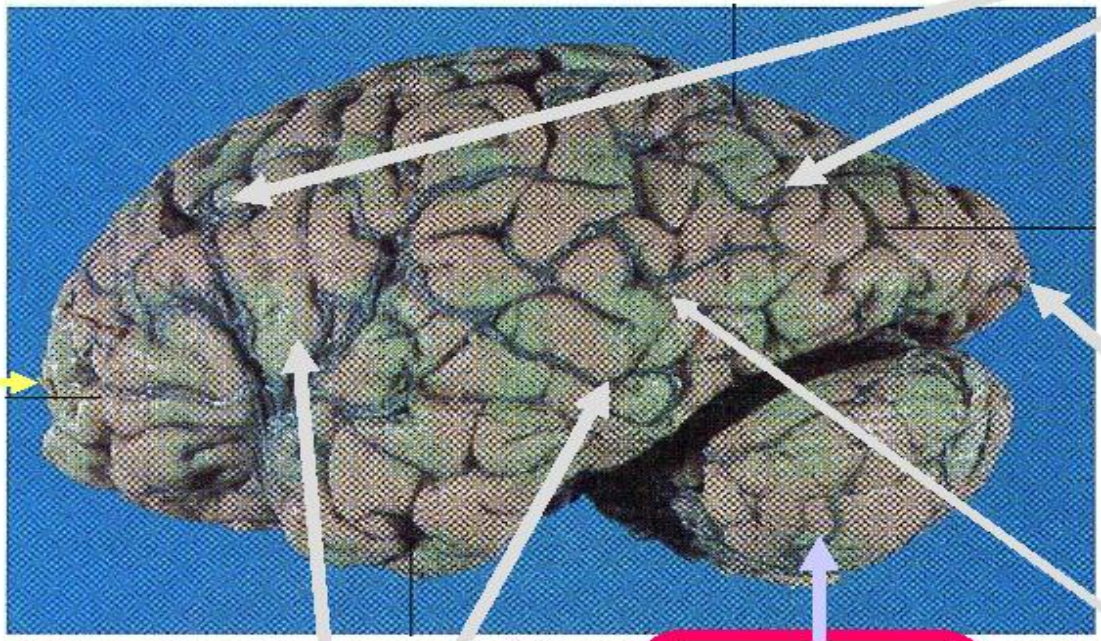
Cognitive psychology – basic assumptions

- the mind consists of a group of interrelated cognitive (information-processing-) processes
- The processes can be studied individually
- Interactions among the processes can also be studied
- Humans use both declarative knowledge (facts) and procedural knowledge (how to do things)
- These two types of knowledge are used in processing stimuli from the environment

Cognitive psychology – 4 main areas

- **perception processes** (processing stimuli from the environement: sight, hearing, touch, taste, smell)
- **memory processes** (learn something new = store it in memory, remember facts = retrieve from memory)
- **thought processes** (reasoning, analysis, problem-solving)
- **language processes** (we receive/produce verbal/written information, inter-human communication)

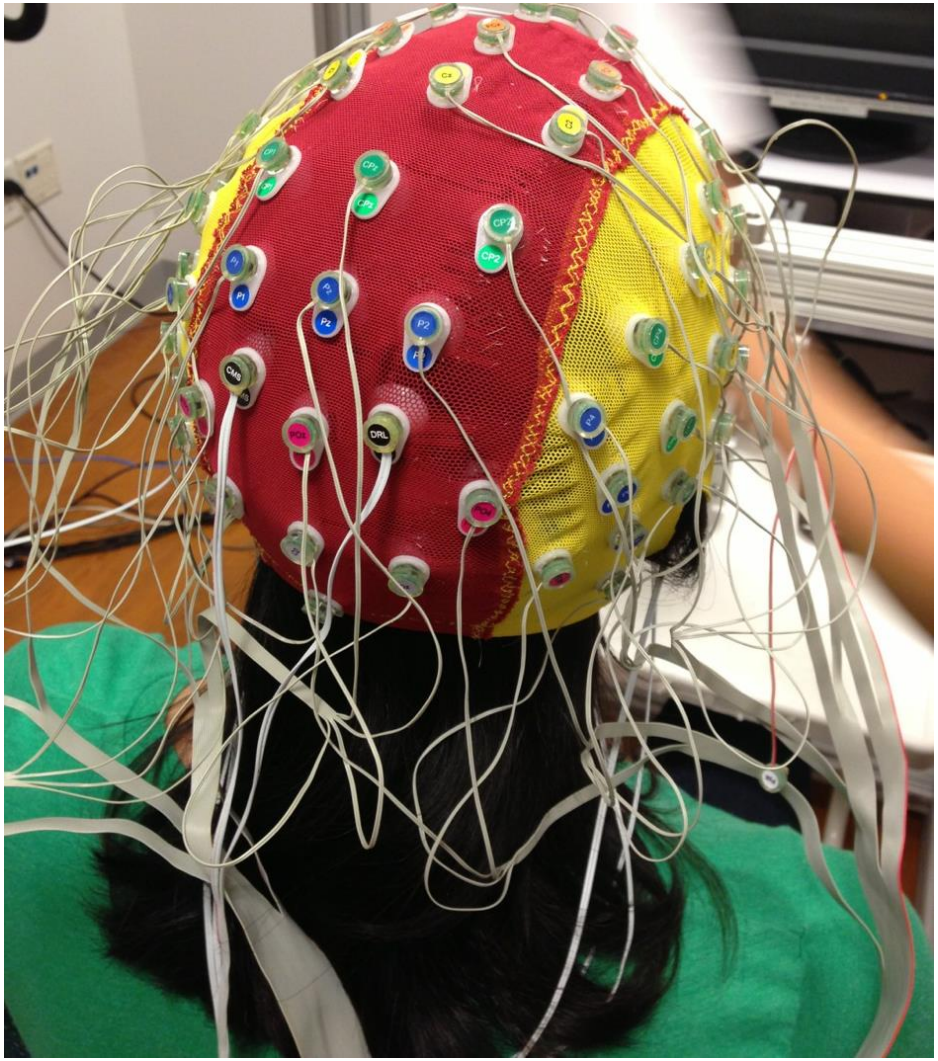
Brain functions/locations



Study of brain activity

- Brain electrical activity measuring electroencephalography EEG
- Measured bands (for adults):
  - Alpha – closed eyes relaxation/reflecting
  - Beta – active calm, alert, focused, active thinking
  - Delta – slow-wave sleep
  - Theta – drowsiness and idling
  - Gamma – cross-modal sensory processing for two different senses like sight and hearing
  - Mu – rest state motor neurons.

EEG



Brain activity – CAT

- CAT – computerized axial tomography

red - high activity,
blue – low activity

eyes and ears open

eyes open, ears closed

eyes closed, ears open

eyes closed, ears closed,

Perception

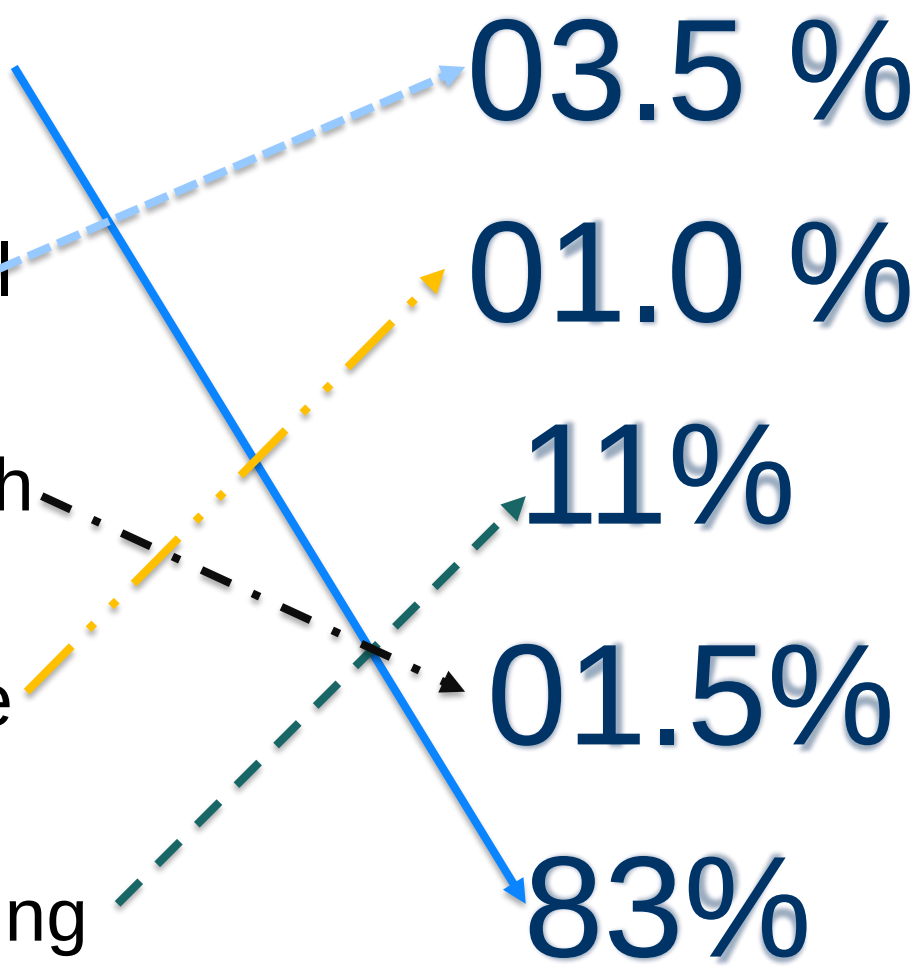
- **Sensory impressions** – result of interaction of stimuli from environment and human sensory organs
- They are then transferred into **representation** in a nervous system that can be processed
- **Perception** is human experience with this representation (for ex. as compared to prior knowledge or experience)

Perception via senses

- Sight – visual or iconic perception
- Hearing – auditive perception
- Smell
- Taste
- Touch – haptic perception

Information distribution – all senses

- Sight
- Smell
- Touch
- Taste
- Hearing



Perception - sight

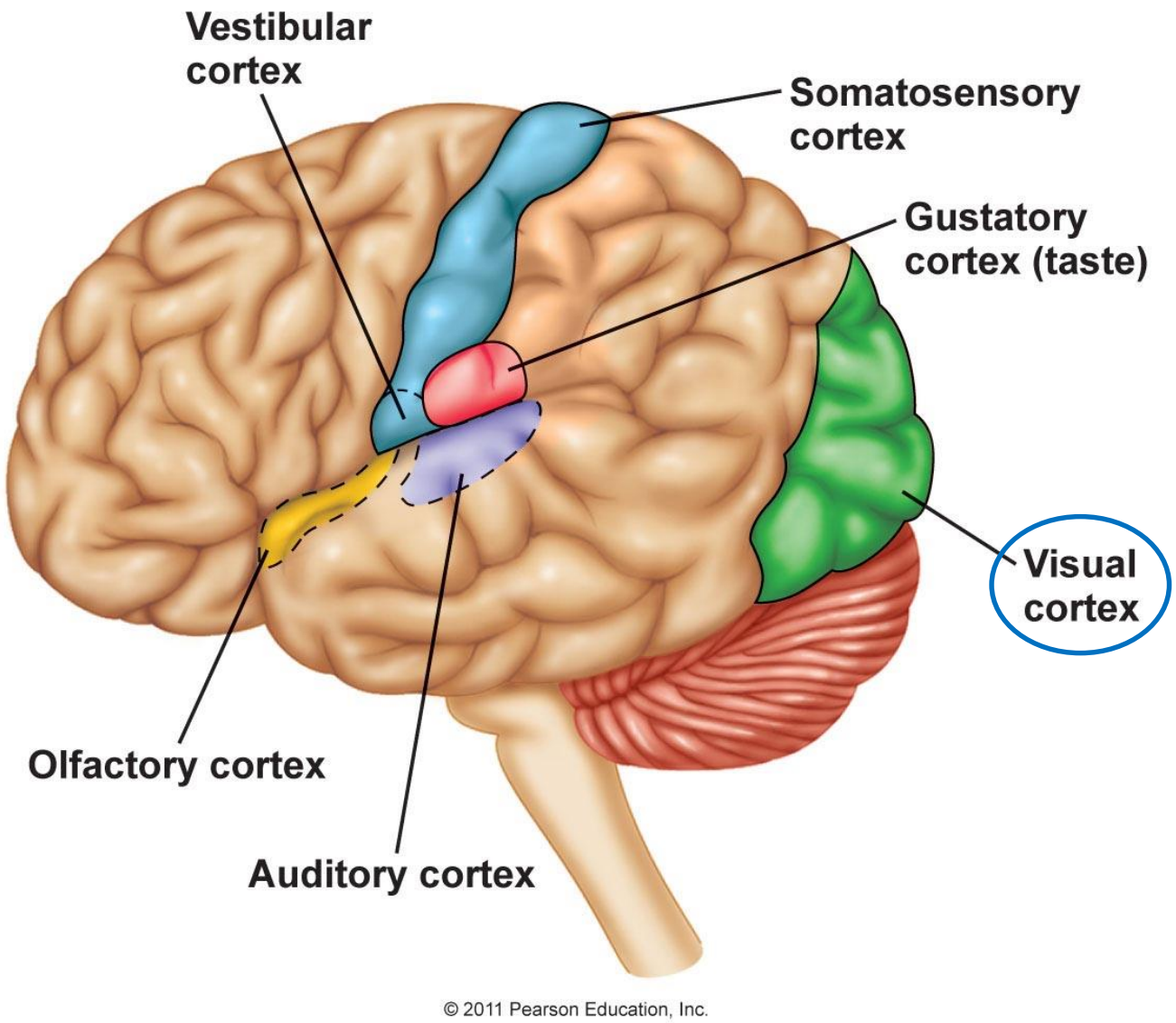
- Most informat

- The visual system is difficult to surpass:
  - bright sunlight and dark nights
  - stills and (fast) moving events
  - we can see far, we can see very small objects
  - we recognize objects without effort vi ser objects are perceived in 3D, ie. where they are located in 3D space

Perception - sight

- the eye is in constant motion:
  - 50-100 ms movement, 200 ms fixation, ie. 3-4 fixations per second
  - fixations give the eye time to focus
  - movement allows us to discover more of the environment – perhaps we see something that we had not intended to look at
    the movements are called saccadic movements

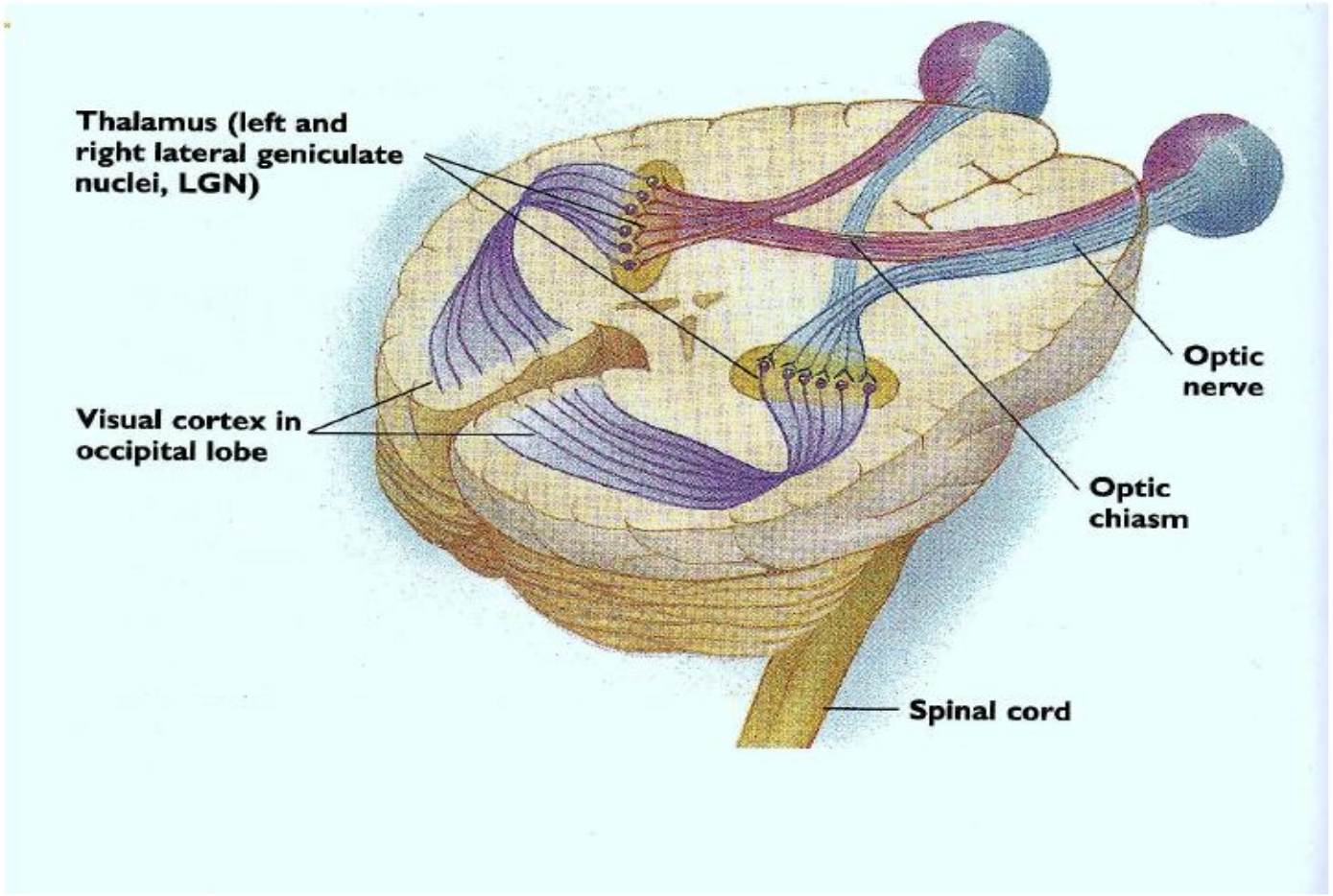
Perseption – sight. Brain response



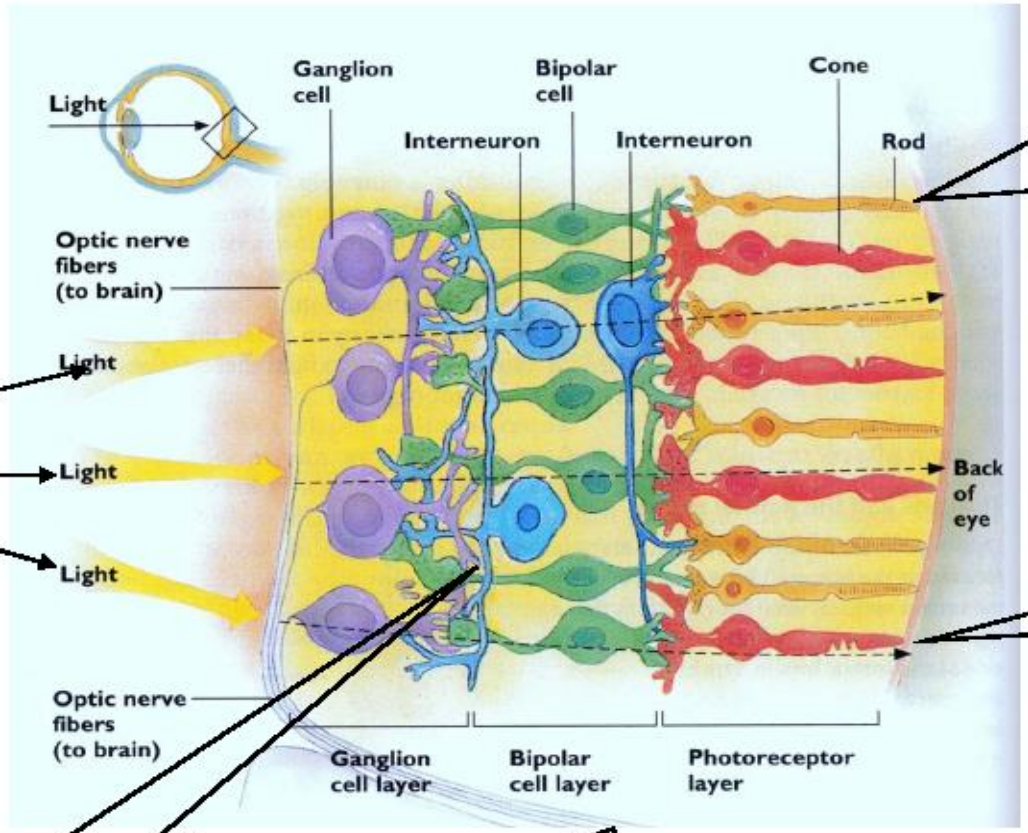
Perseption – sight. Brain response

Sight

Stimuli go to either the right or left side of the eye



Eye cells



rods – black/white vision

receptors

cones – colour

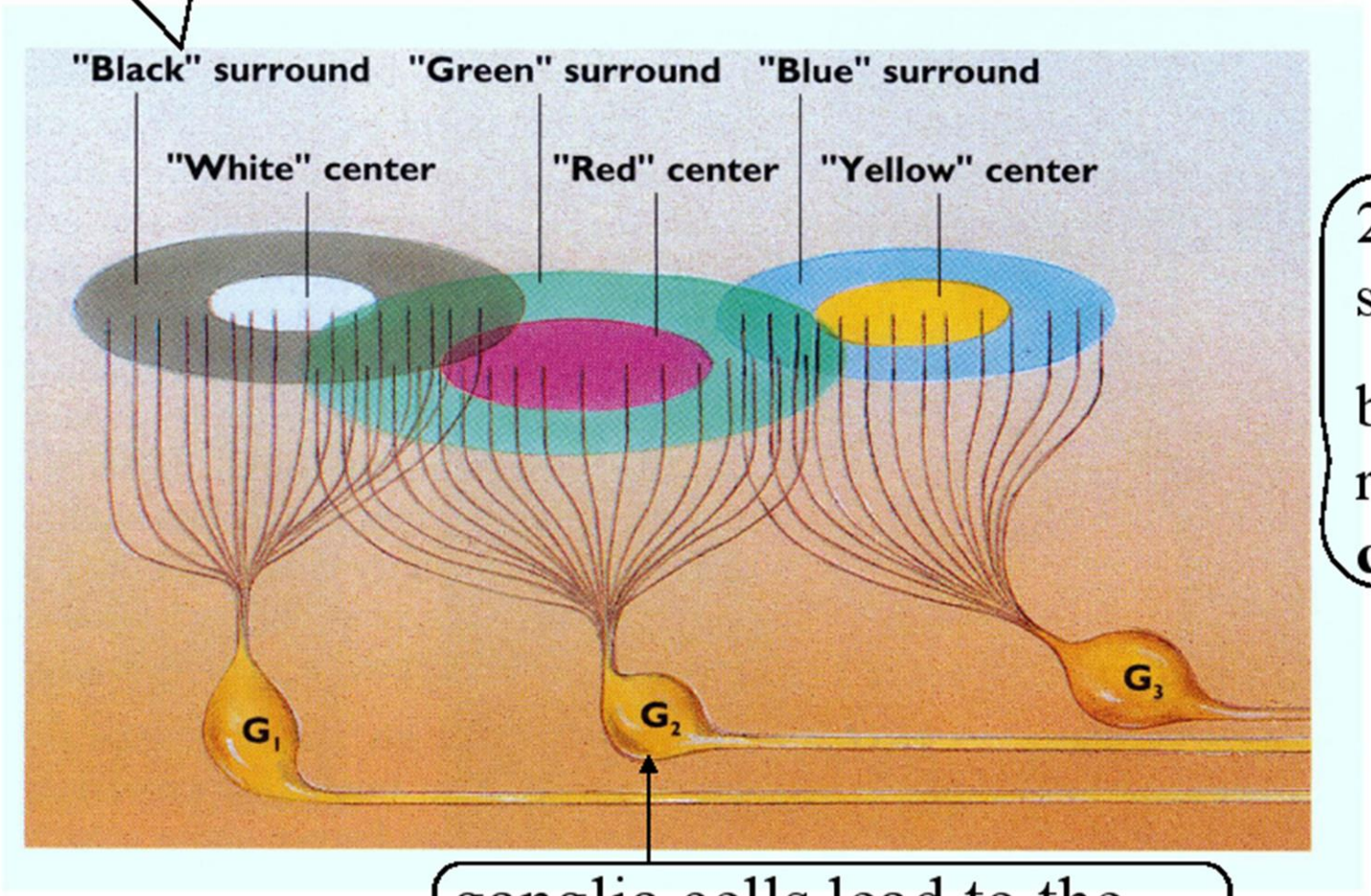
light-waves (stimuli)

cells connected to each other

optic nerve that goes to the brain

The eye's three colour systems

1 b/w system: **rods**



2 colour systems:

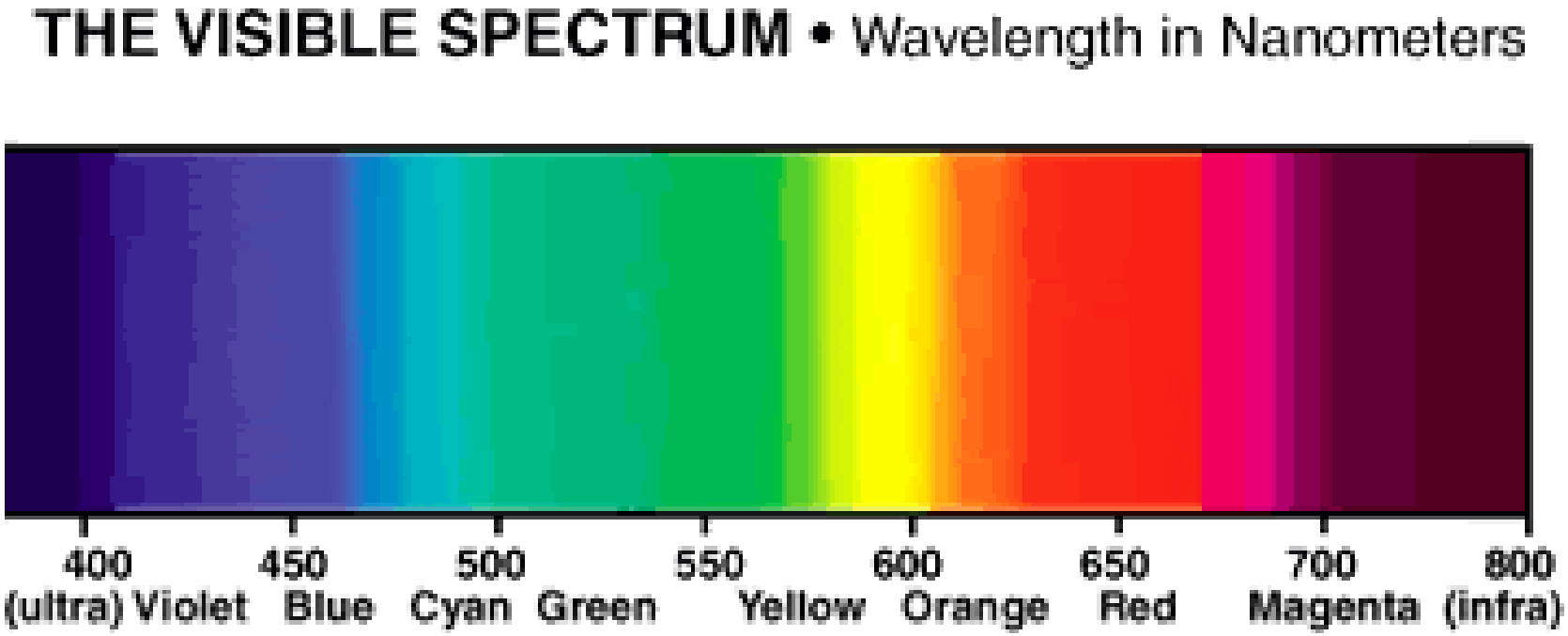
blue-yellow
red-green
cones

ganglia cells lead to the optic nerve

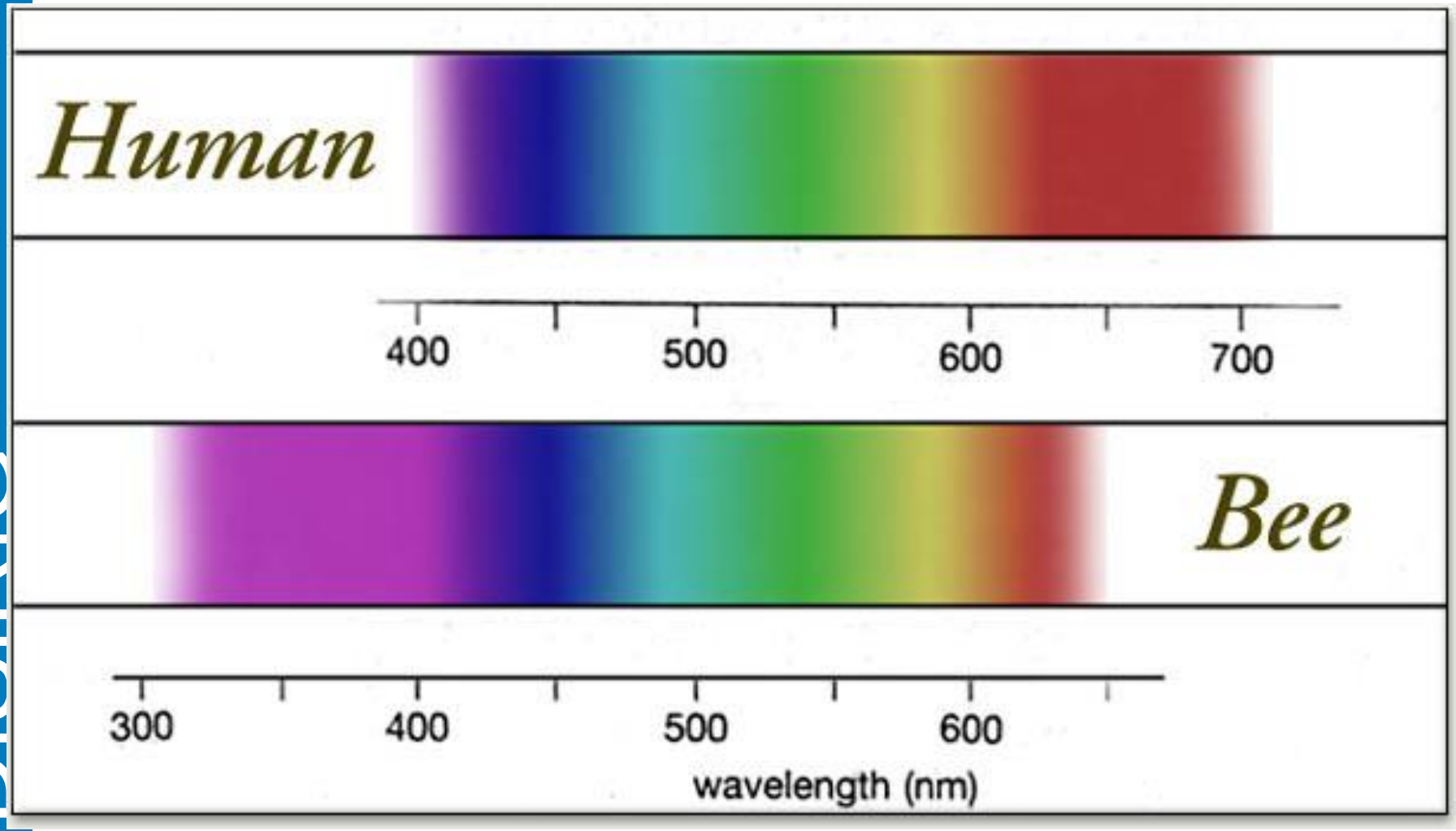
Rods and cones

- We have 6 m cones (colour) and 100 m rods
- The number of rods allows vision in detail in bright light and that we can also see in the dark The cones are most dense in the centre of the retina where it is easiest to focus
- There are three kinds of cones which react to long, medium and short wave lengths (corresponding approximately to red/green/blue)
- Combinations of these wavelengths allow us to 'create' all the other colours

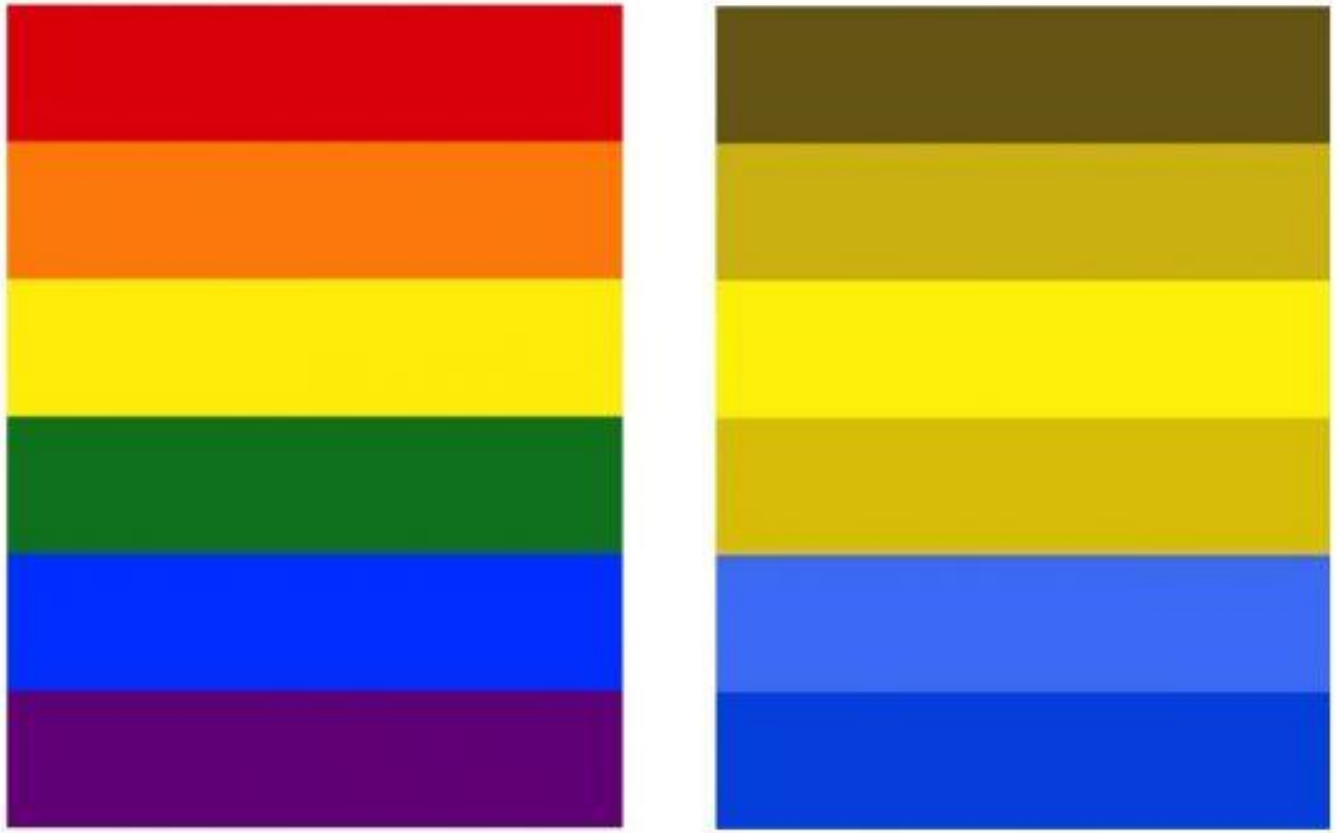
Colors we can see



Colors a bee can see



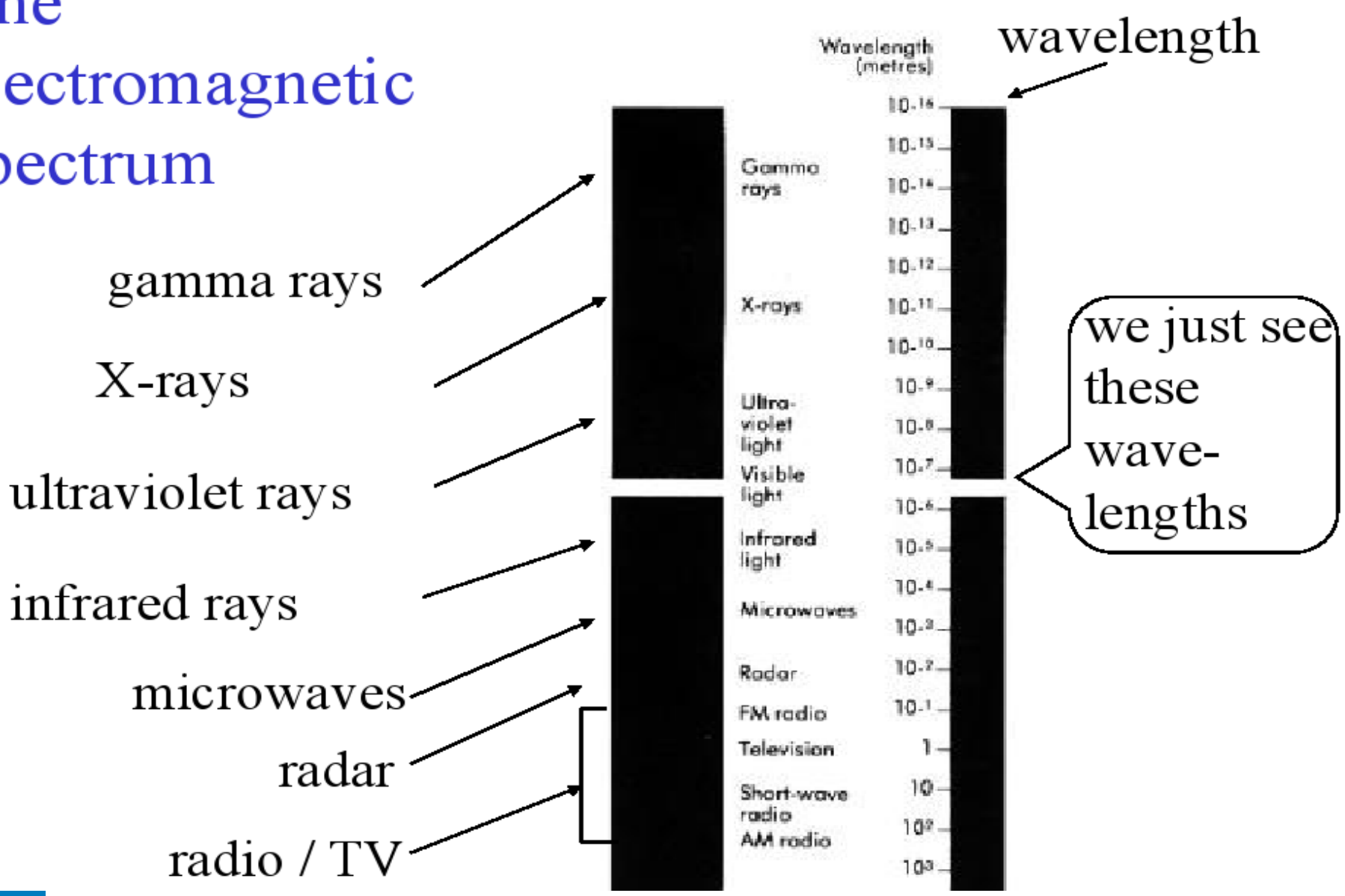
Colors a dog can see



What a Human Sees

What a Dog Sees

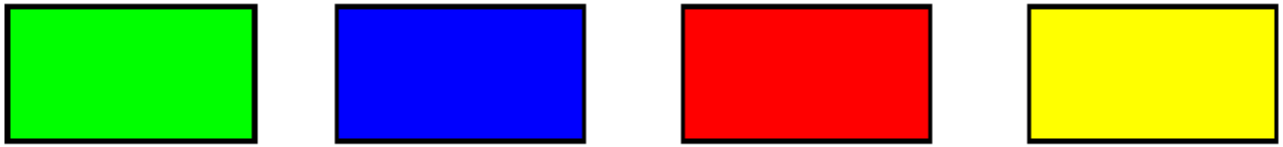
The electromagnetic spectrum



- Color – a light energy (of a certain wavelength) interpretation in visual center
- Three color components:
  - Hue – actual color determined by wavelength (as in red or green)
  - Saturation – cleanness of the color when one wavelength dominates over others
  - Brightness – how much light is reflected.

Hue and saturation

hue



saturation

Red-green test