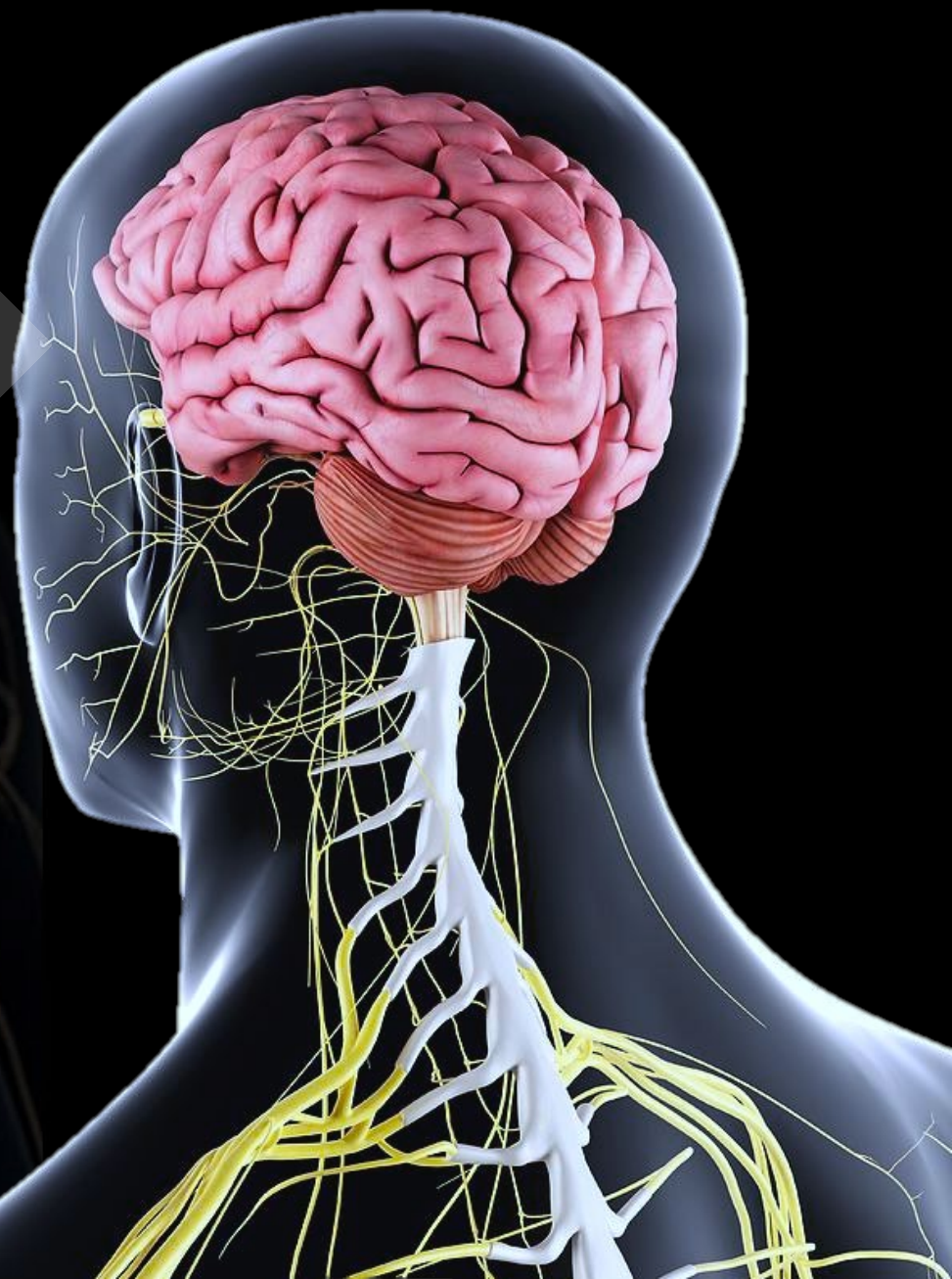
BRAIN

THE HUMAN CPU

Anan Srikiatkhachorn, MD@KMITL

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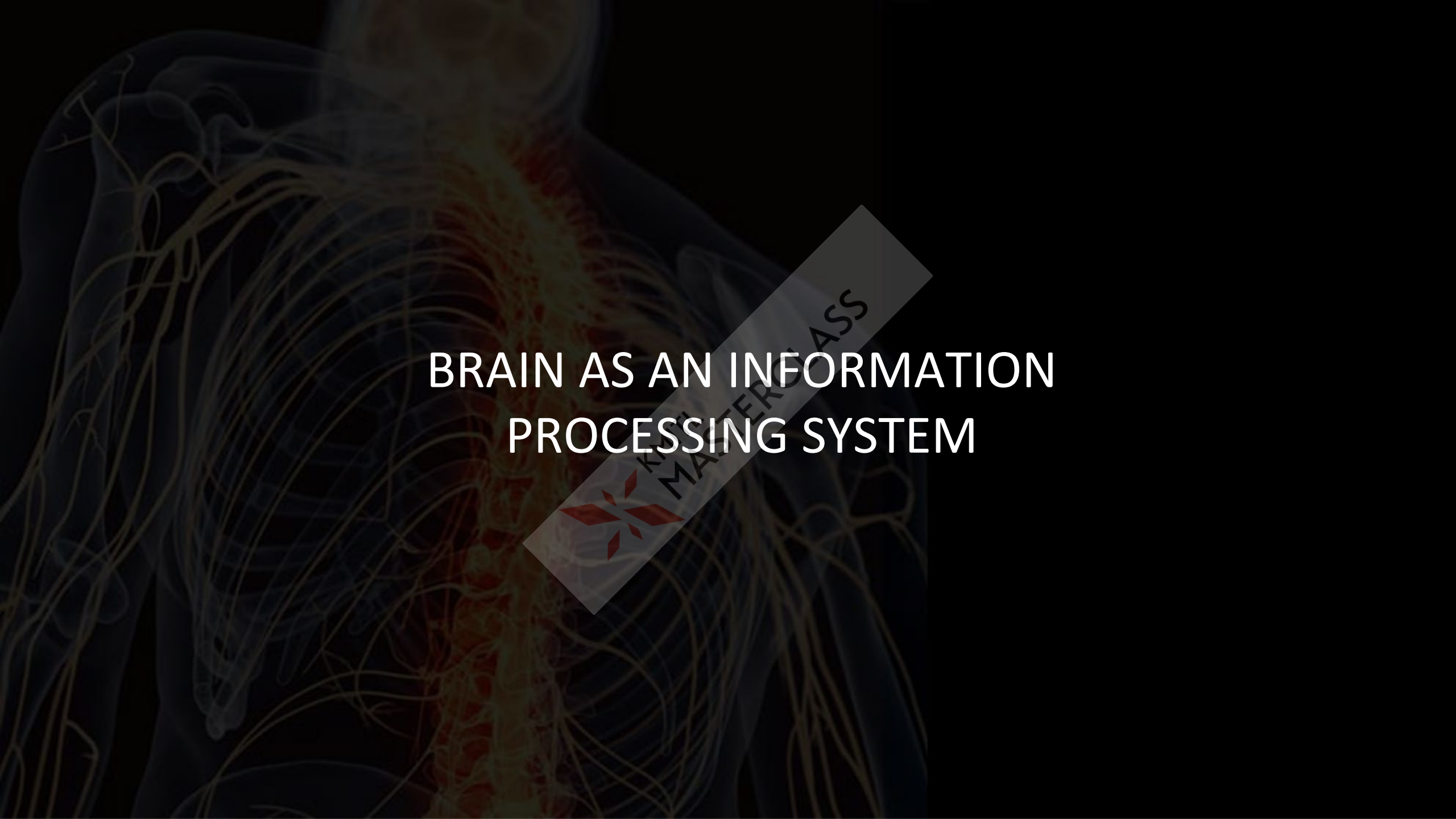


BRAIN AS AN INFORMATION PROCESSING SYSTEM

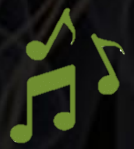
TOUCH

PRESSURE

Data in computer language

IMAGE

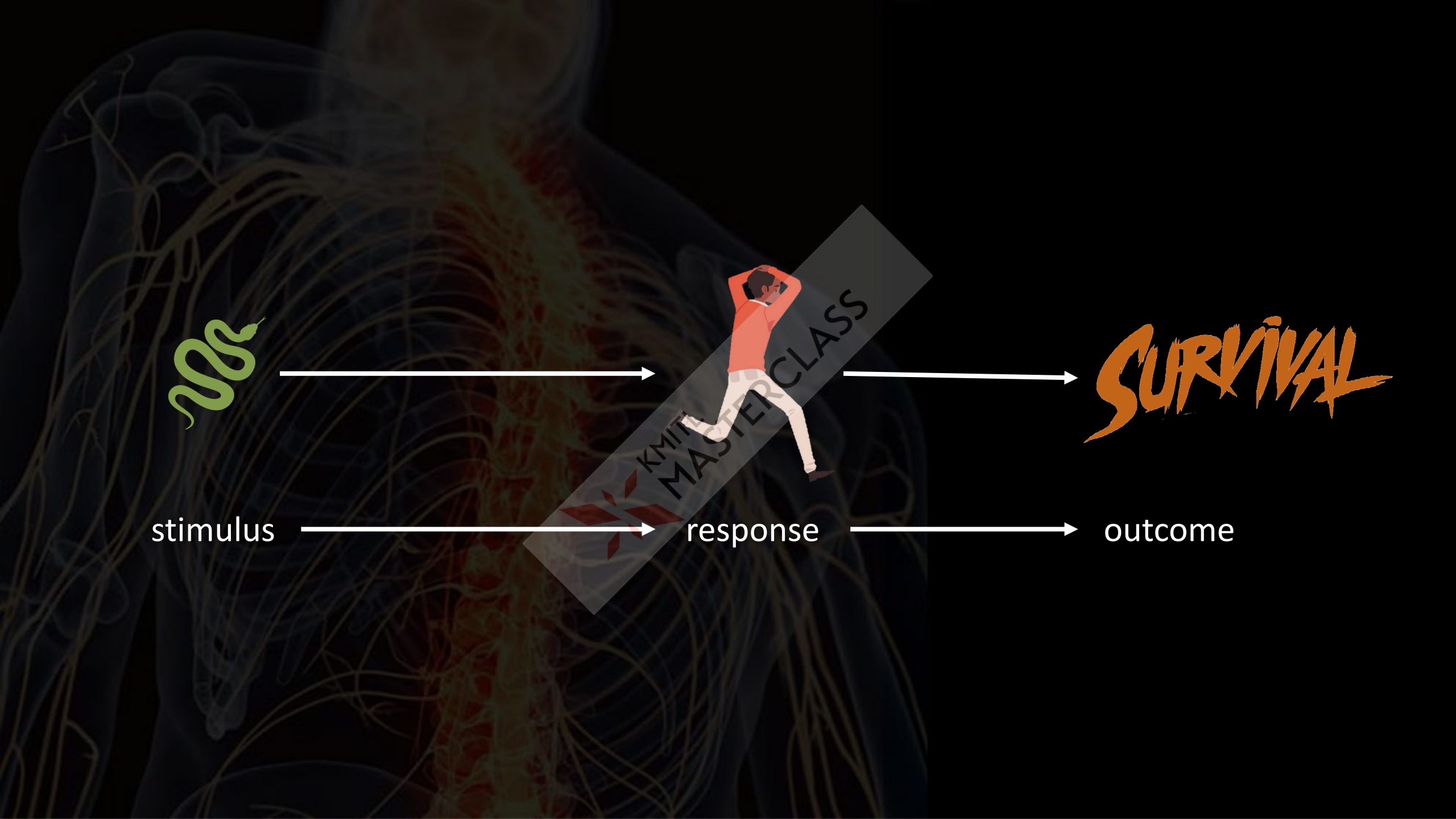
LIGHT



SOUND

VIBRATION

SENSORY PROCESSING → CENTRAL PROCESSING → EFFECTOR → RESPONSES


SURVIVAL
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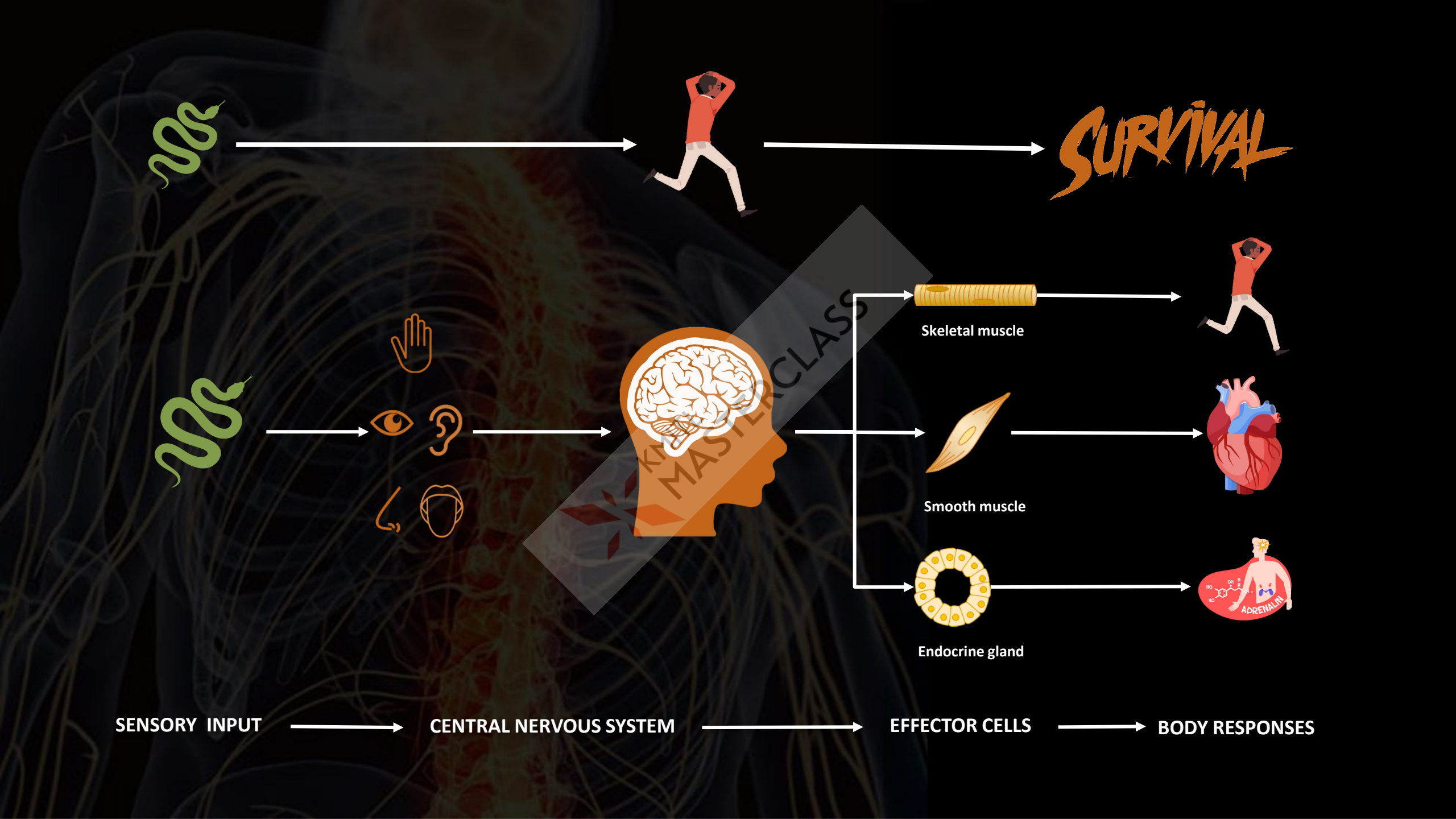
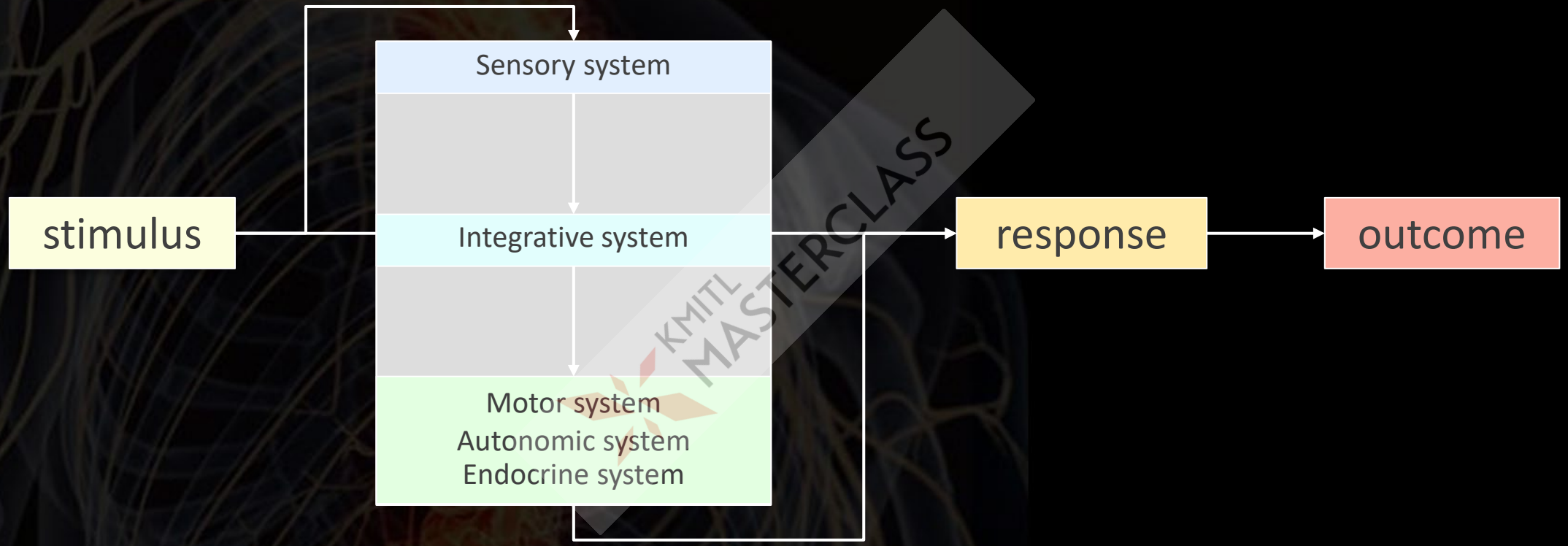
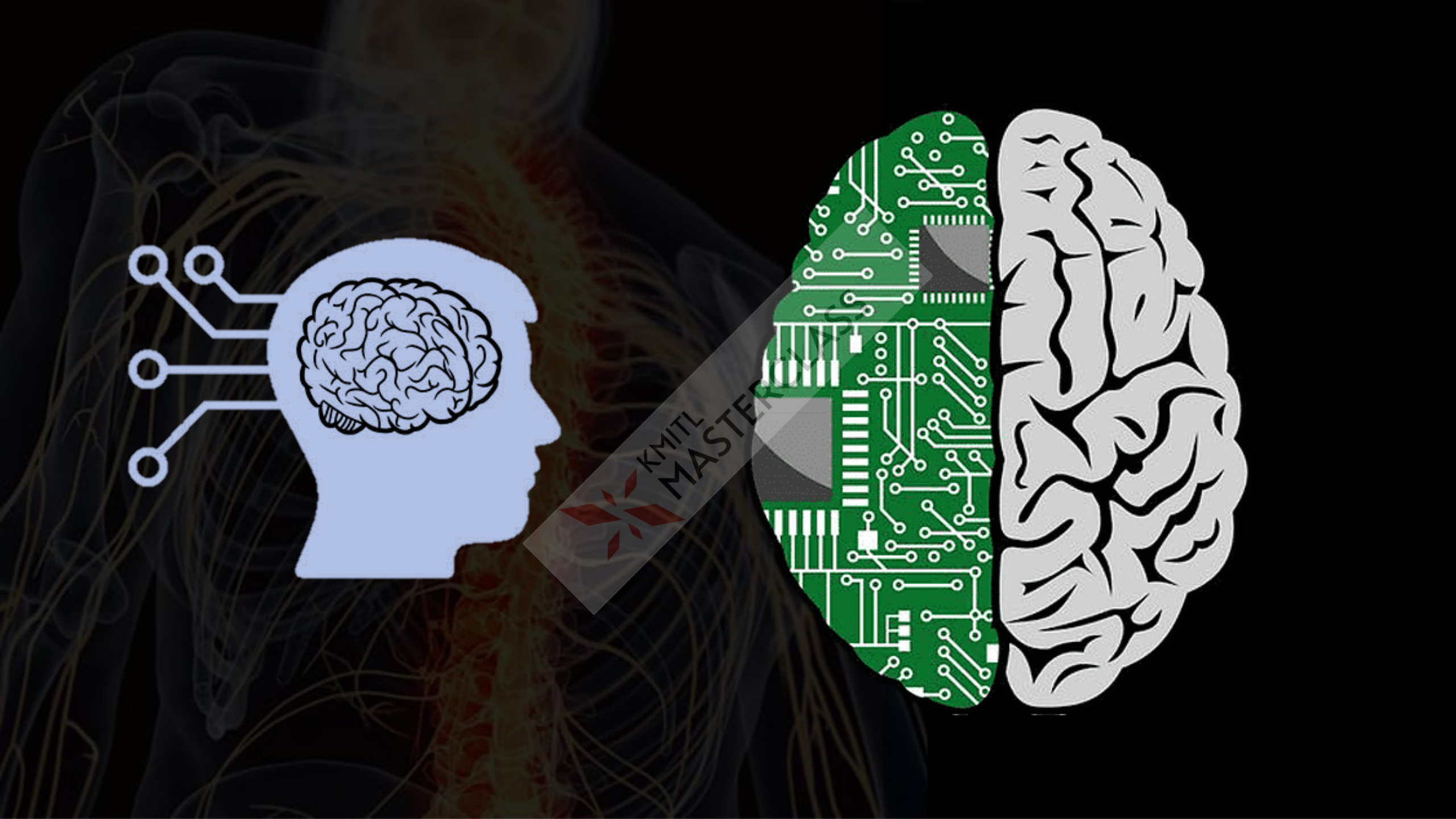
stimulus
response
outcome


SURVIVAL
Skeletal muscle
Smooth muscle
Endocrine gland
ADRENALIN
SENSORY INPUT
CENTRAL NERVOUS SYSTEM
EFFECTOR CELLS
BODY RESPONSES


Sensory system
stimulus
Integrative system
response
outcome
Motor system
Autonomic system
Endocrine system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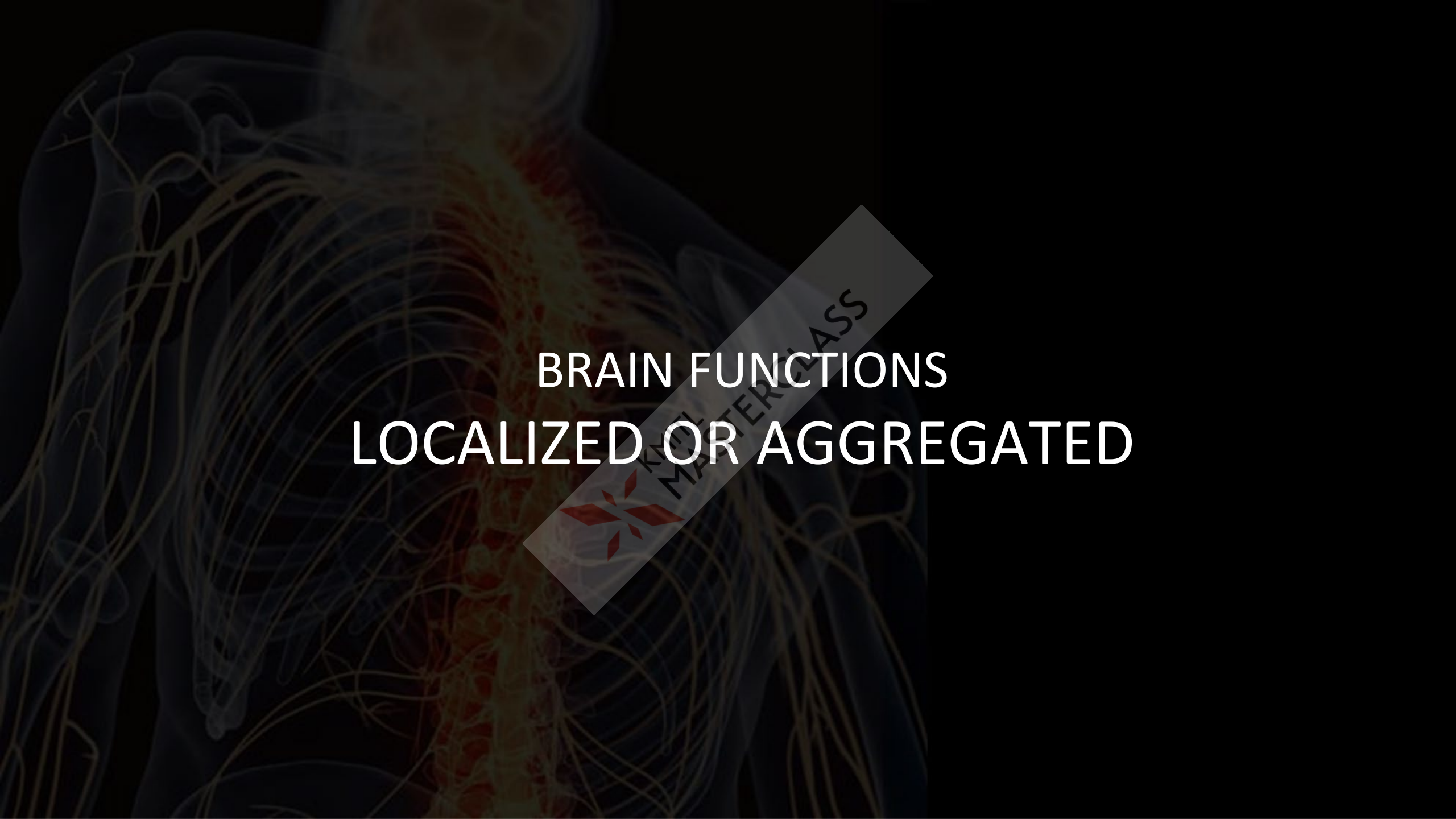
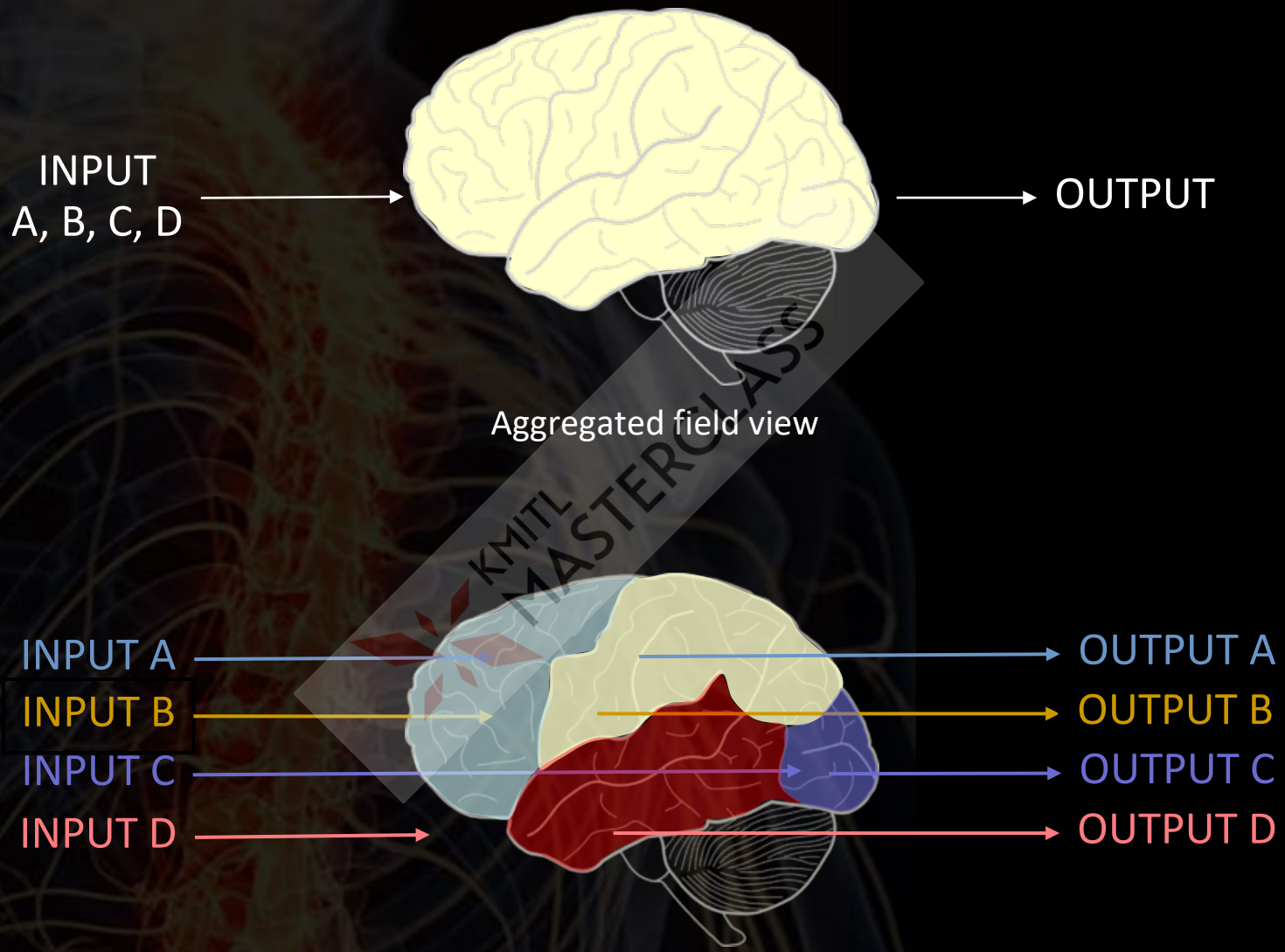
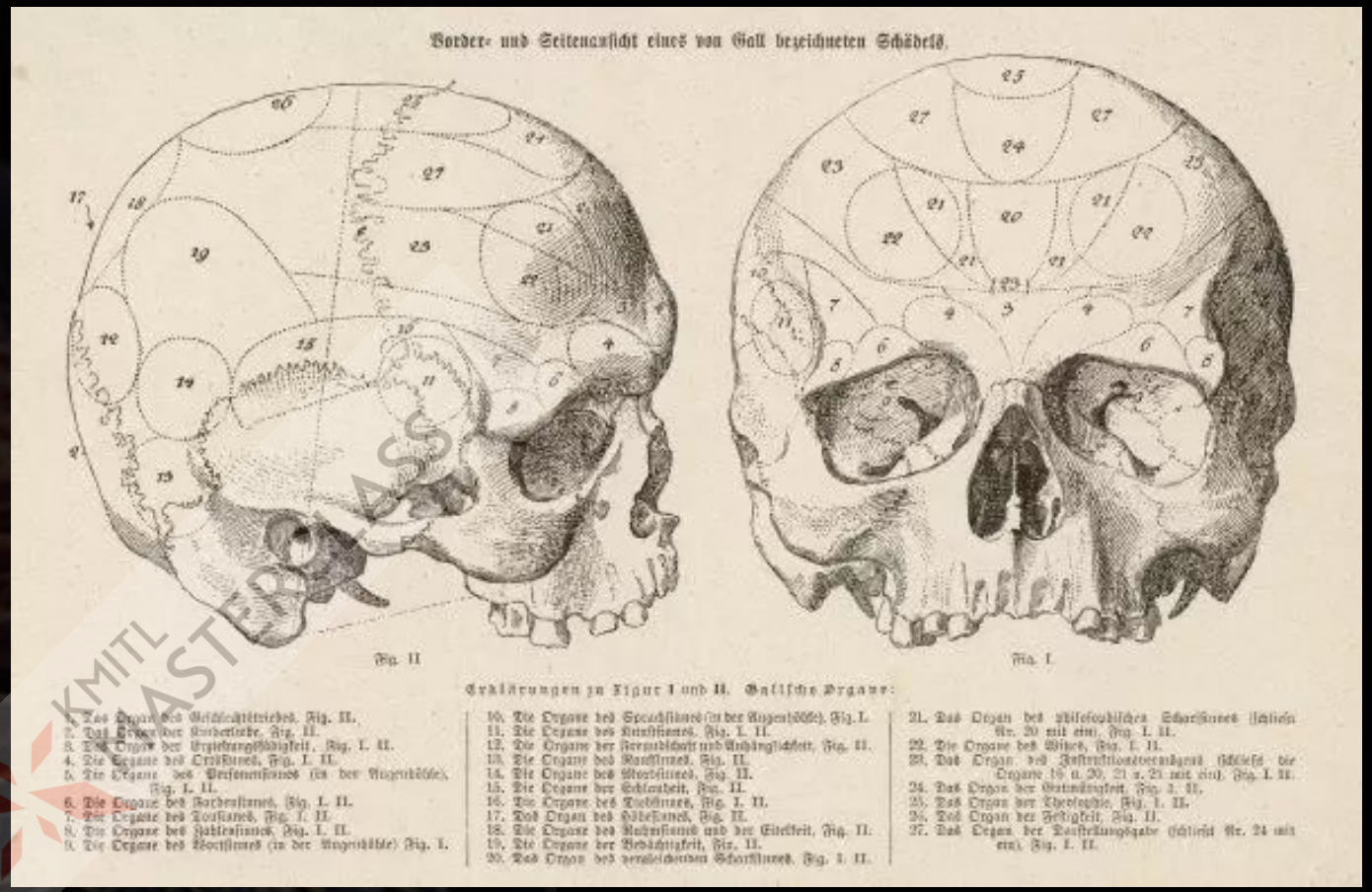


BRAIN FUNCTIONS
LOCALIZED OR AGGREGATED


INPUT
A, B, C, D
OUTPUT
Aggregated field view
INPUT A
INPUT B
INPUT C
INPUT D
OUTPUT A
OUTPUT B
OUTPUT C
OUTPUT D
Localization view



Franz Joseph Gall

and the Origins of Phrenology


PHRENOLOGY CHARACTERS
GOOD WIFE
GOSSIP MONGER
WEAK SPIRITED
CRIMINAL
QUICK TEMPER
RESPEC
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The Improbable Tale of PHINEAS GAGE

Mr. Phineas Gage may well be the most famous clinical subject in neuroanatomy. A foreman on the New England railroads in the 19th Century, Gage, at age 25, was pierced through the head with a 13-pound tamping iron while preparing a railroad bed in Vermont. The rod went straight through Gage's skull and landed several yards away. Although the front left portion of Gage's brain was effectively destroyed, he was still able to talk and move with relative ease.


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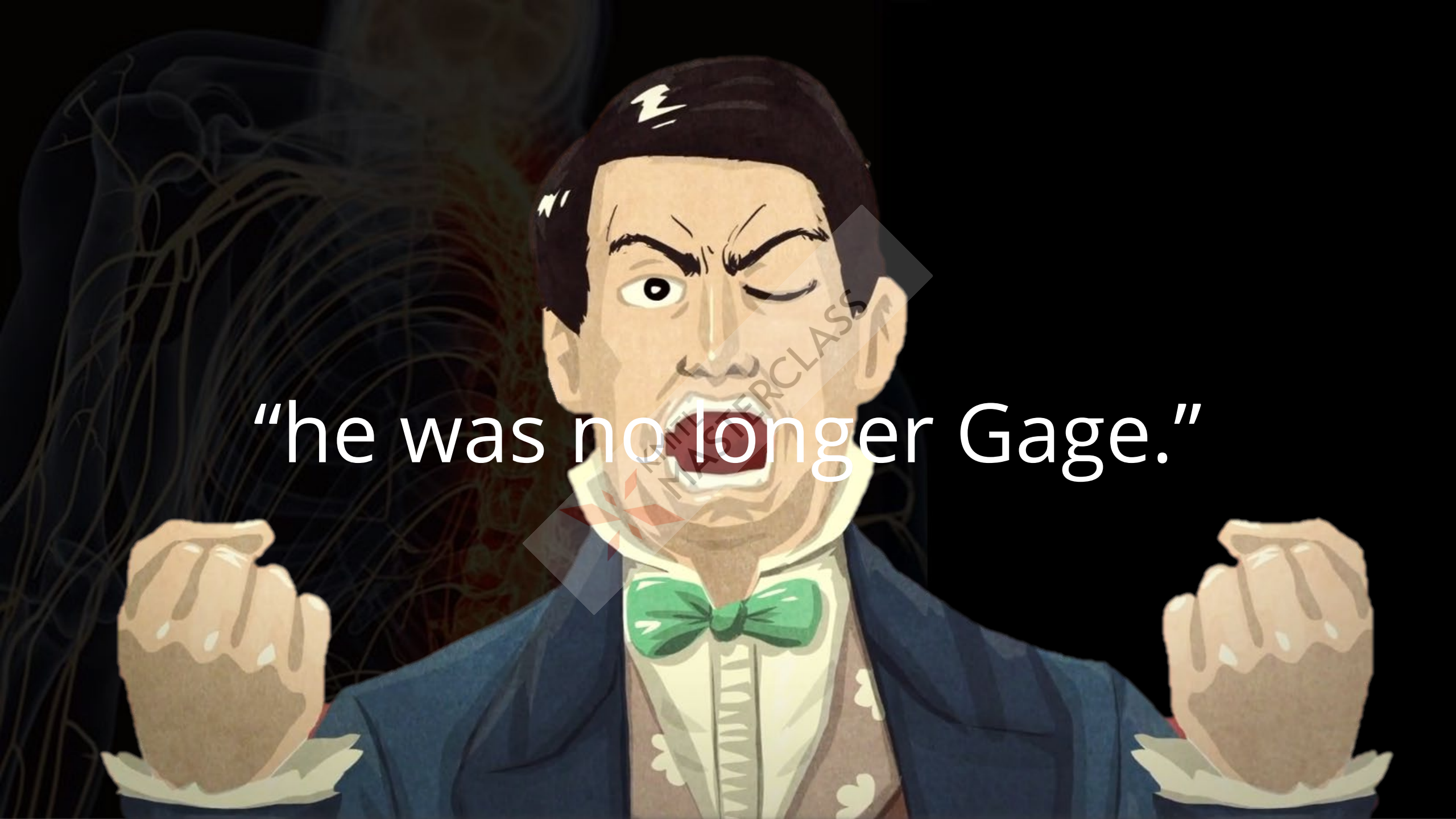
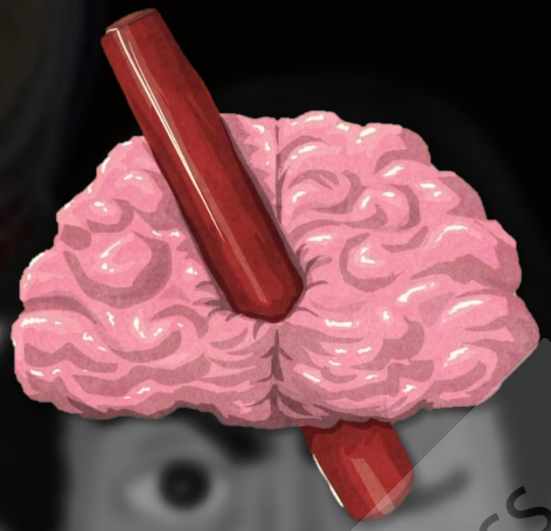
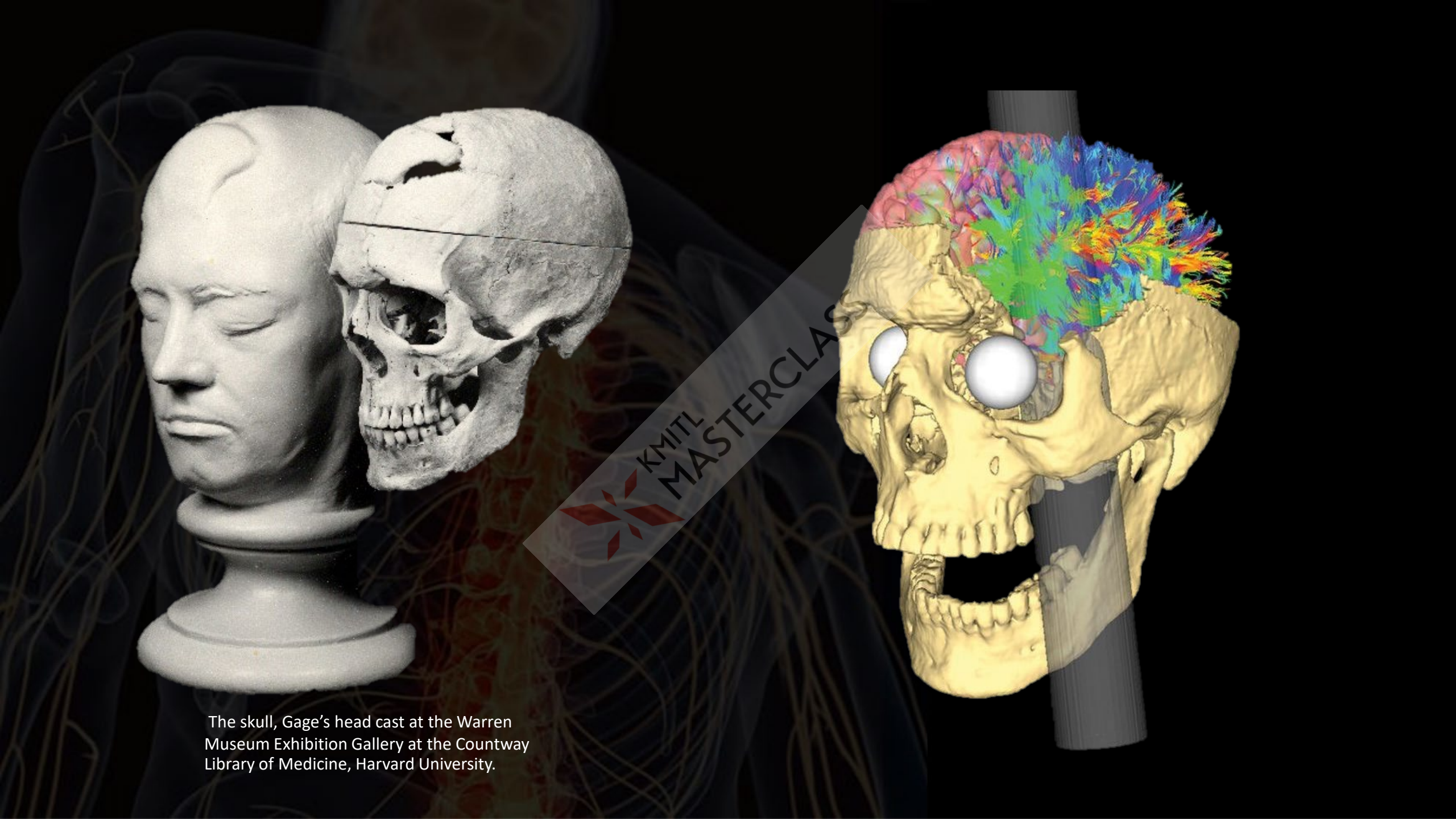

“he was no longer Gage.”



HORRIBLE ACCIDENT.—Phineas P. Gage, a foreman on the Rutland Railroad at Cavendish, Vt., was preparing for a blast on Wednesday last, when the powder exploded, carrying through his head an iron instrument, an inch and a fourth in circumference, and three feet and eight inches in length.—The iron entered on the side of his face, shattering the upper jaw, and passing back of the left eye, and out at the top of his head. Singularly enough, he was alive at two o'clock the next afternoon, in full possession of his reason, and free from pain.



The skull, Gage's head cast at the Warren Museum Exhibition Gallery at the Countway Library of Medicine, Harvard University.


Pierre Paul Broca
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Pierre Paul Broca
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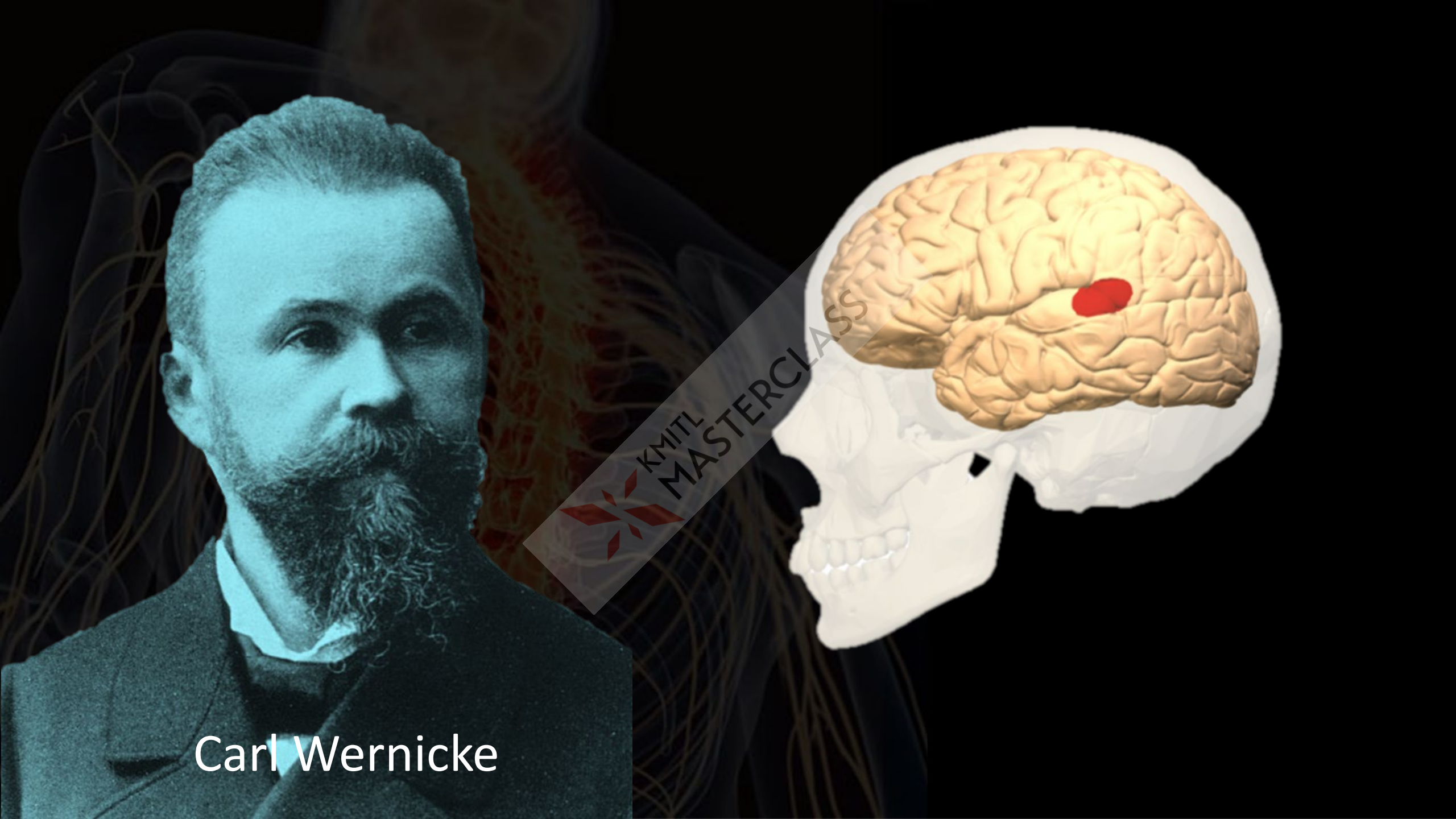


Carl Wernicke

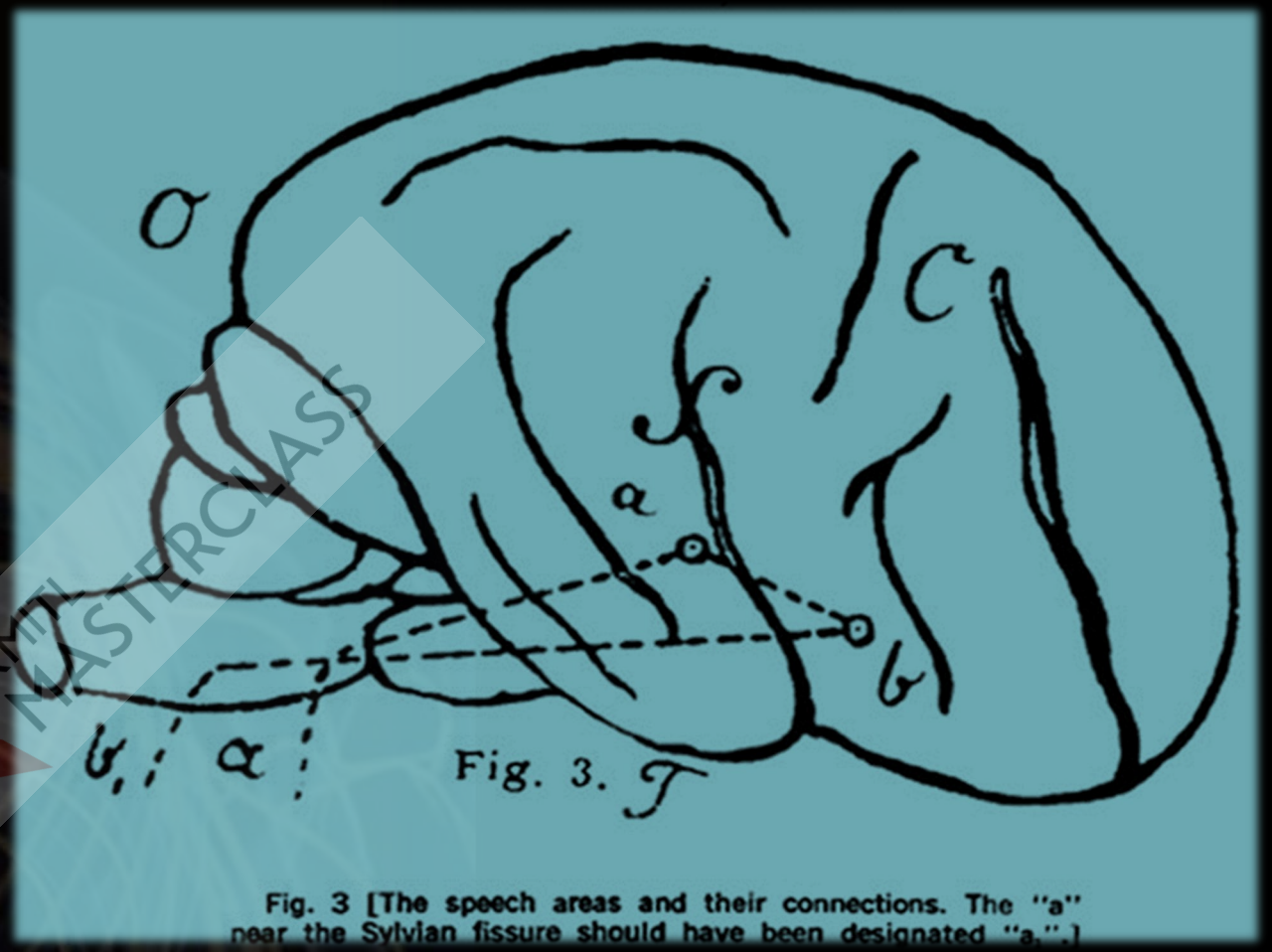
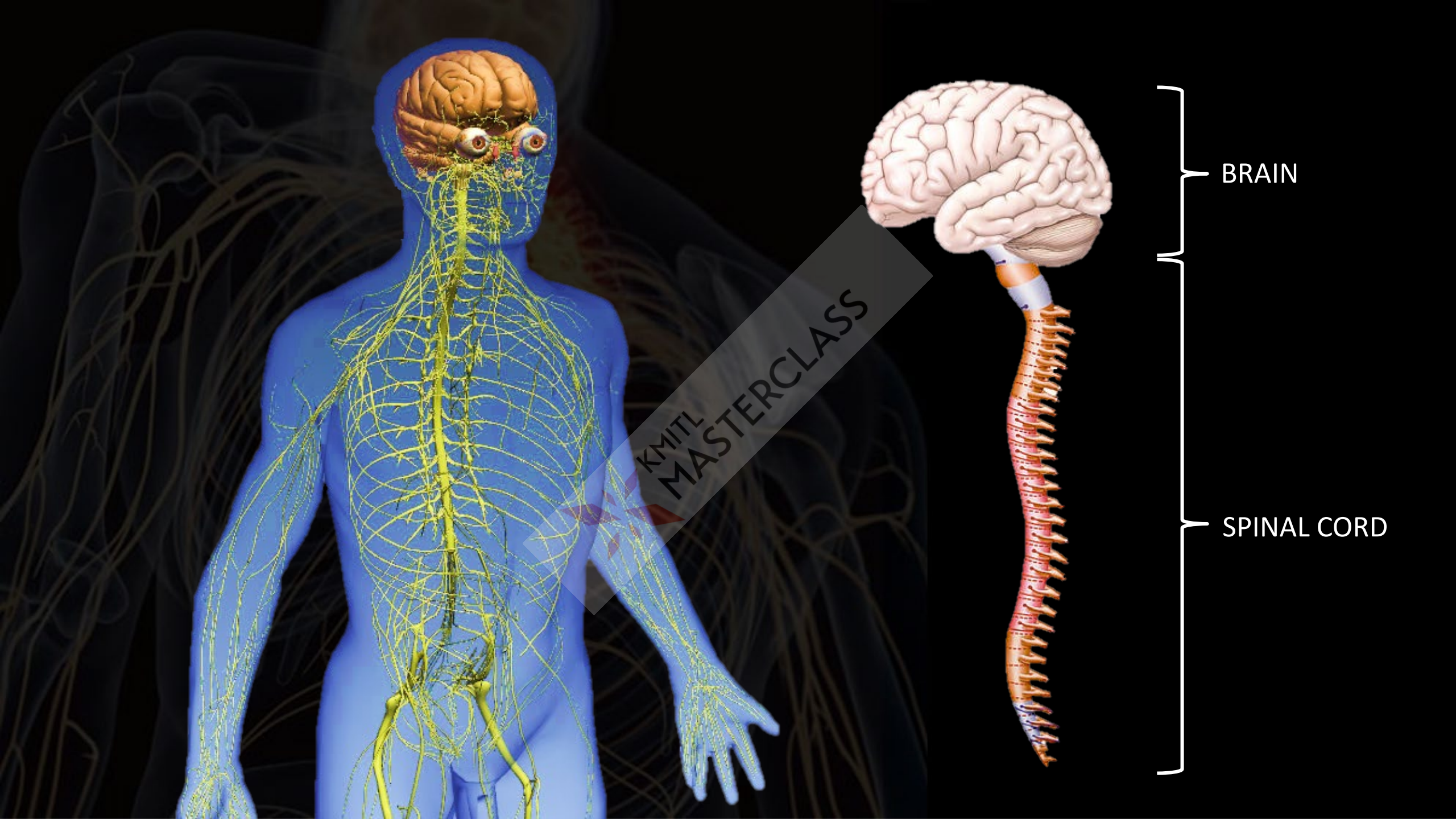


Fig. 3 [The speech areas and their connections. The "a" near the Sylvian fissure should have been designated "a."]


BRAIN
SPINAL CORD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superior

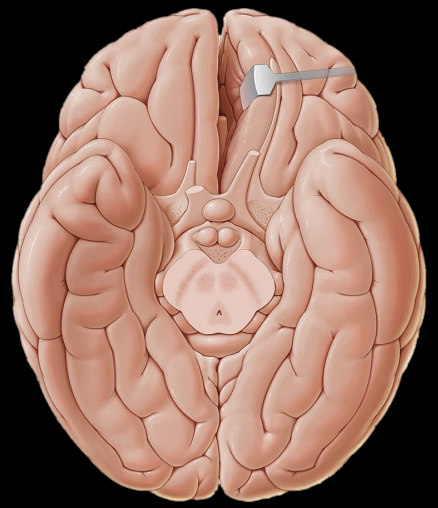
anterior

posterior

inferior

SIDE VIEW (LEFT)

anterior



right

left

posterior

BOTTOM VIEW

superior

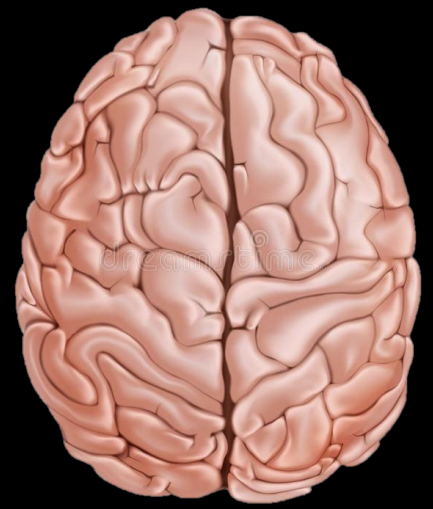
right

left

inferior

FRONT VIEW

anterior

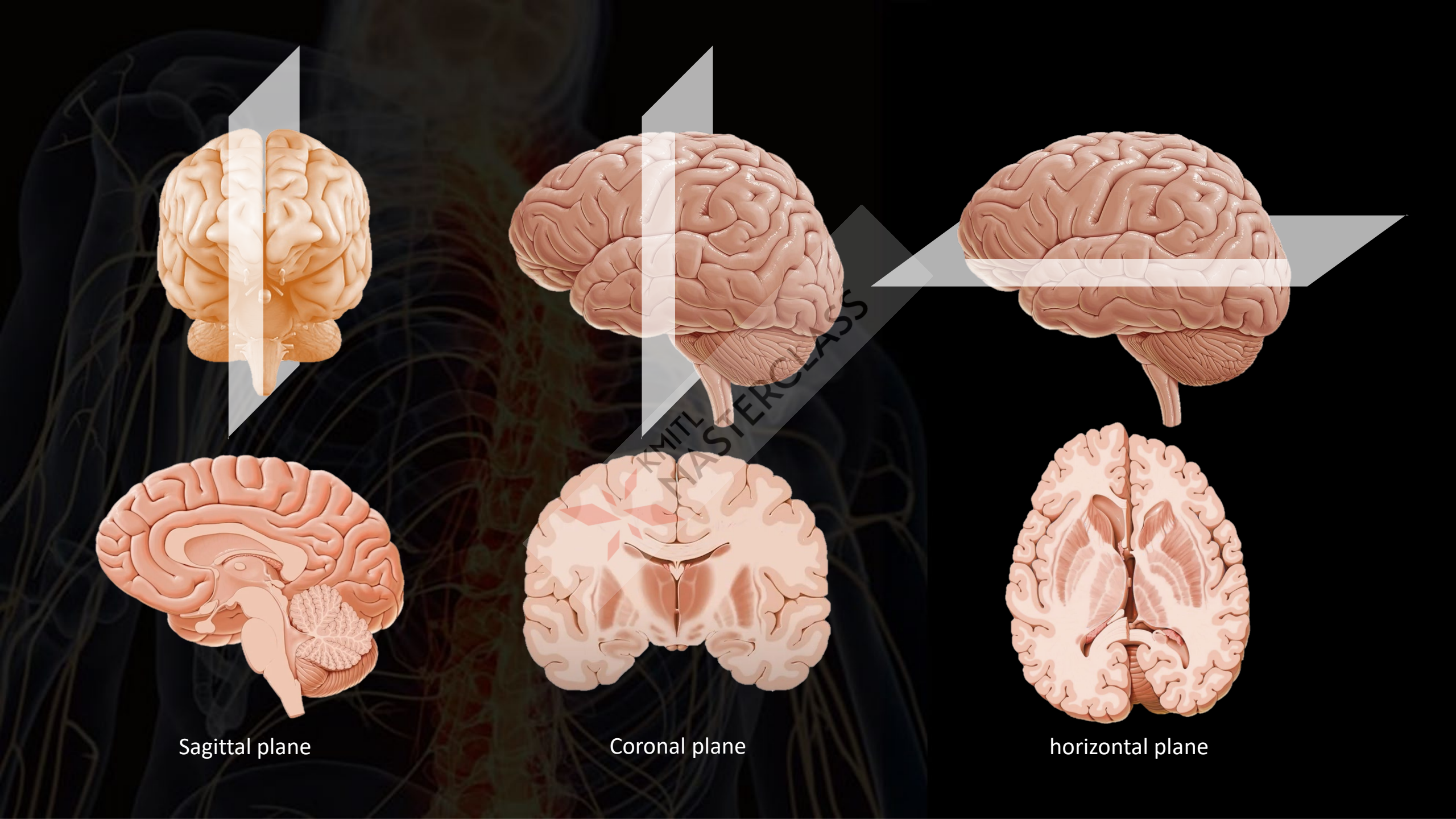


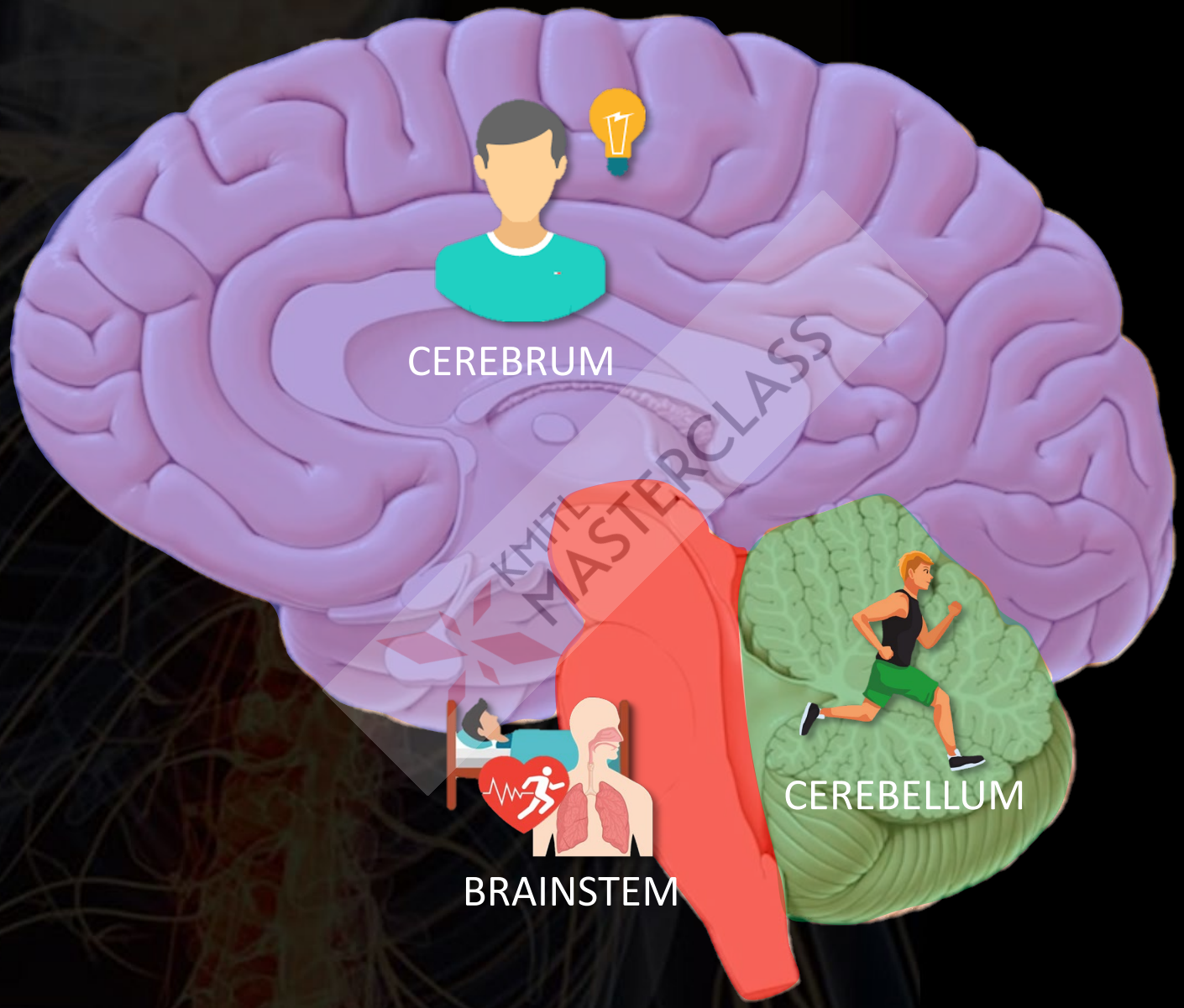
right

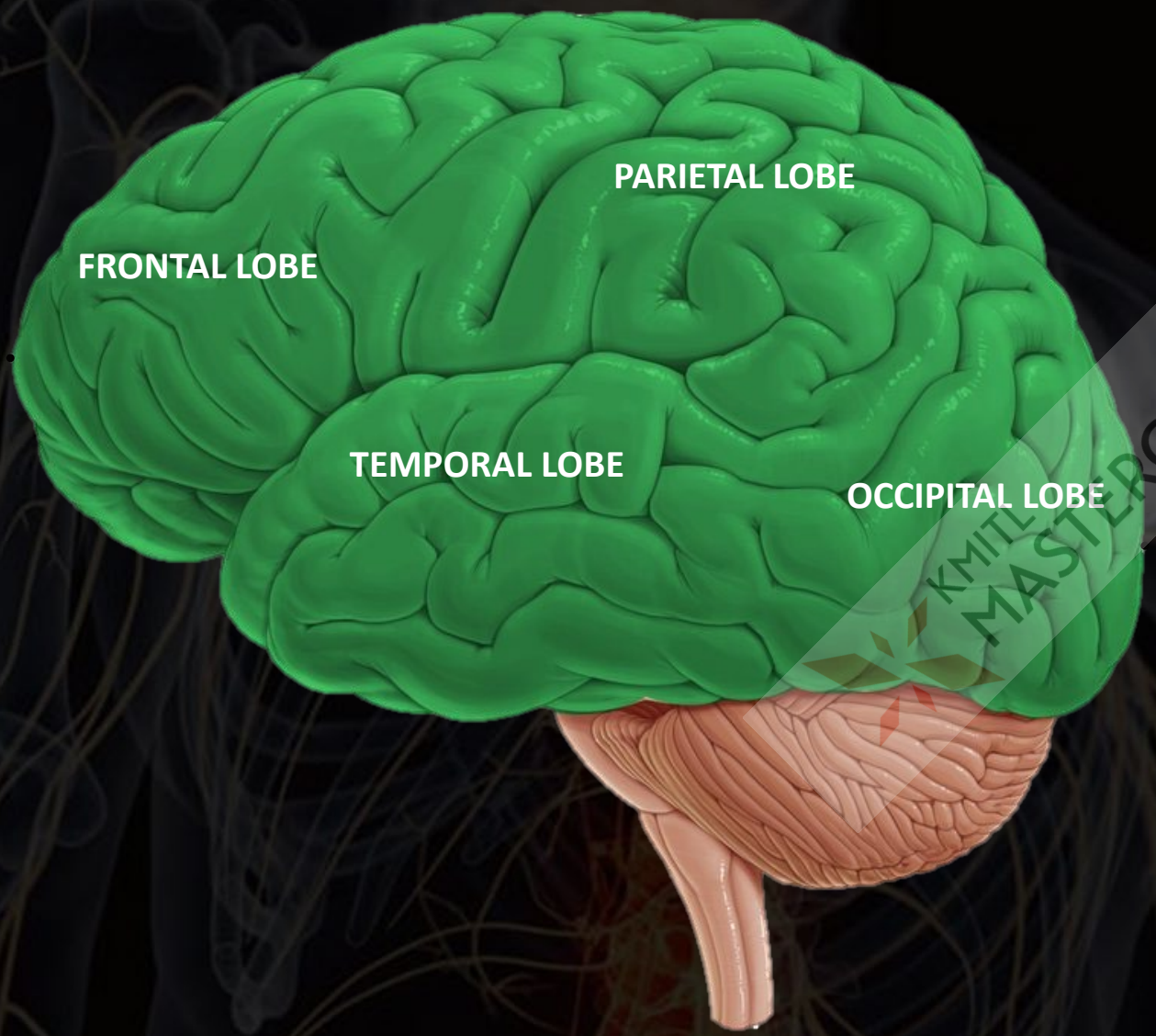
left

posterior

TOP VIEW

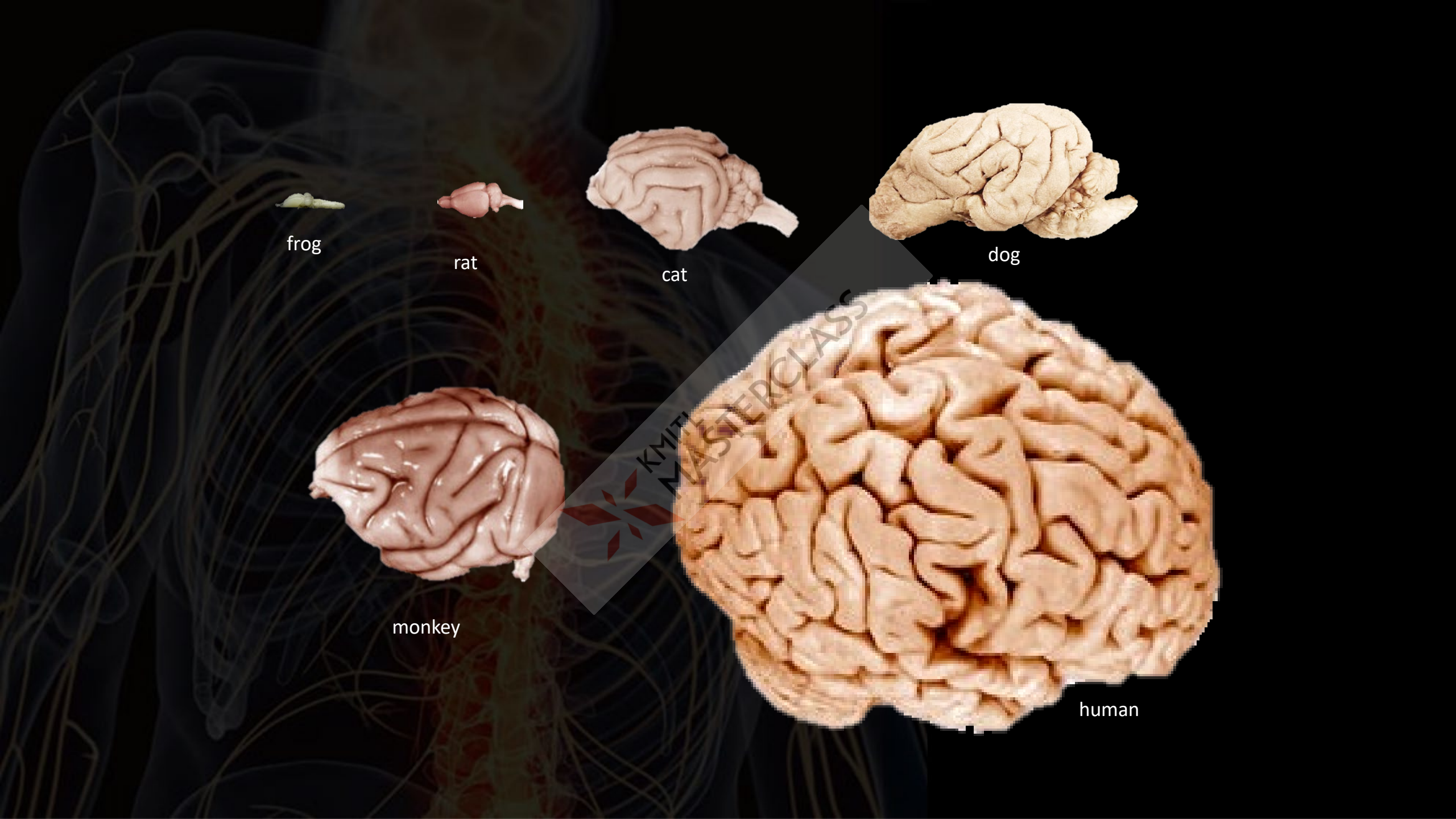

Sagittal plane
Coronal plane
horizontal plane

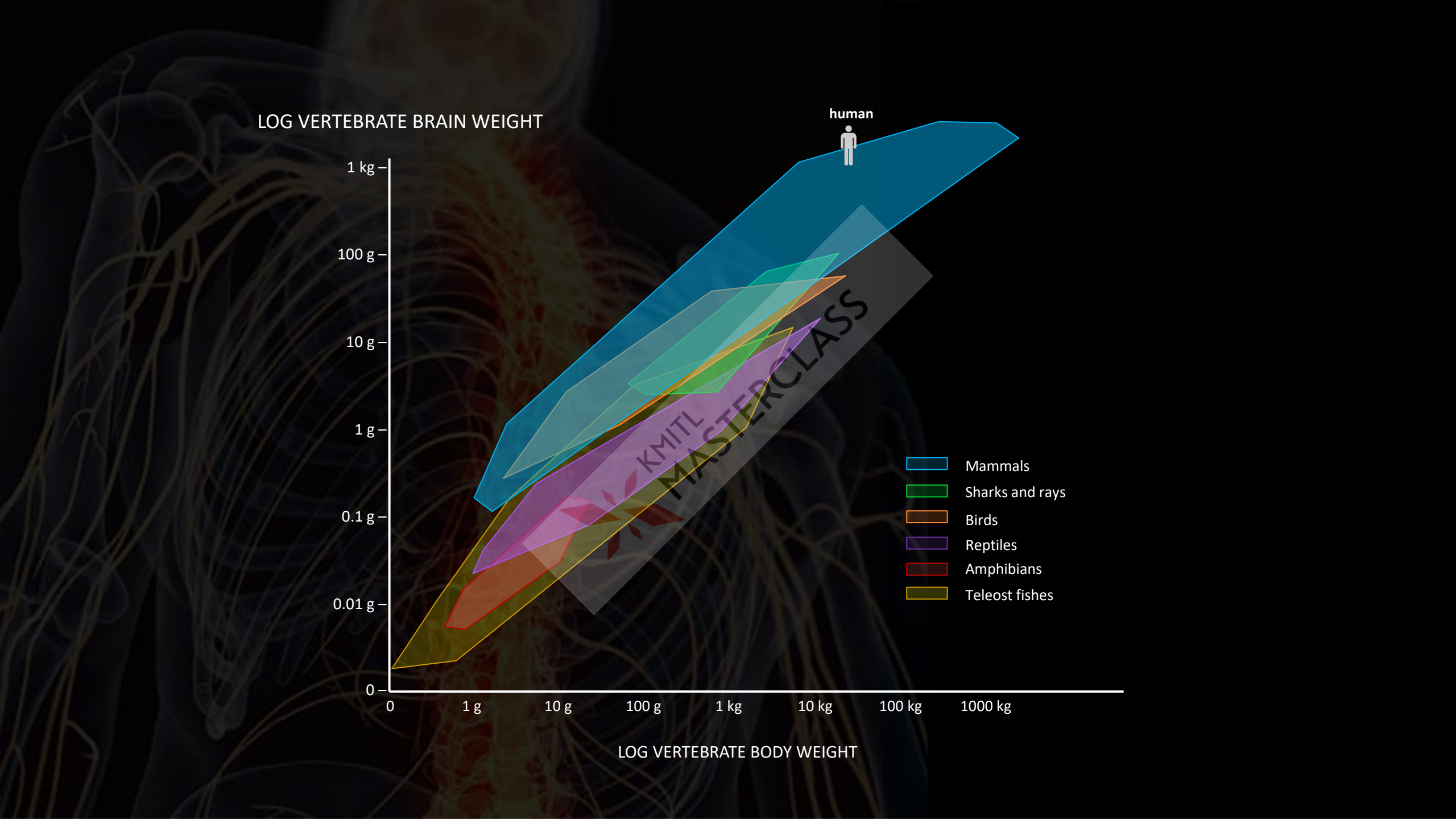

CEREBRUM
CEREBELLUM
BRAINSTEM



Cerebral cortex

- Localizes and interprets sensory inputs
- Controls voluntary and skills skeletal muscle activity
- Acts in intellectual and emotional processing


frog
rat
cat
dog
monkey
human


LOG VERTEBRATE BRAIN WEIGHT
human
1 kg
100 g
10 g
1 g
0.1 g
0.01 g
0
0
1 g
10 g
100 g
1 kg
10 kg
100 kg
1000 kg
LOG VERTEBRATE BODY WEIGHT
Mammals
Sharks and rays
Birds
Reptiles
Amphibians
Teleost fishes
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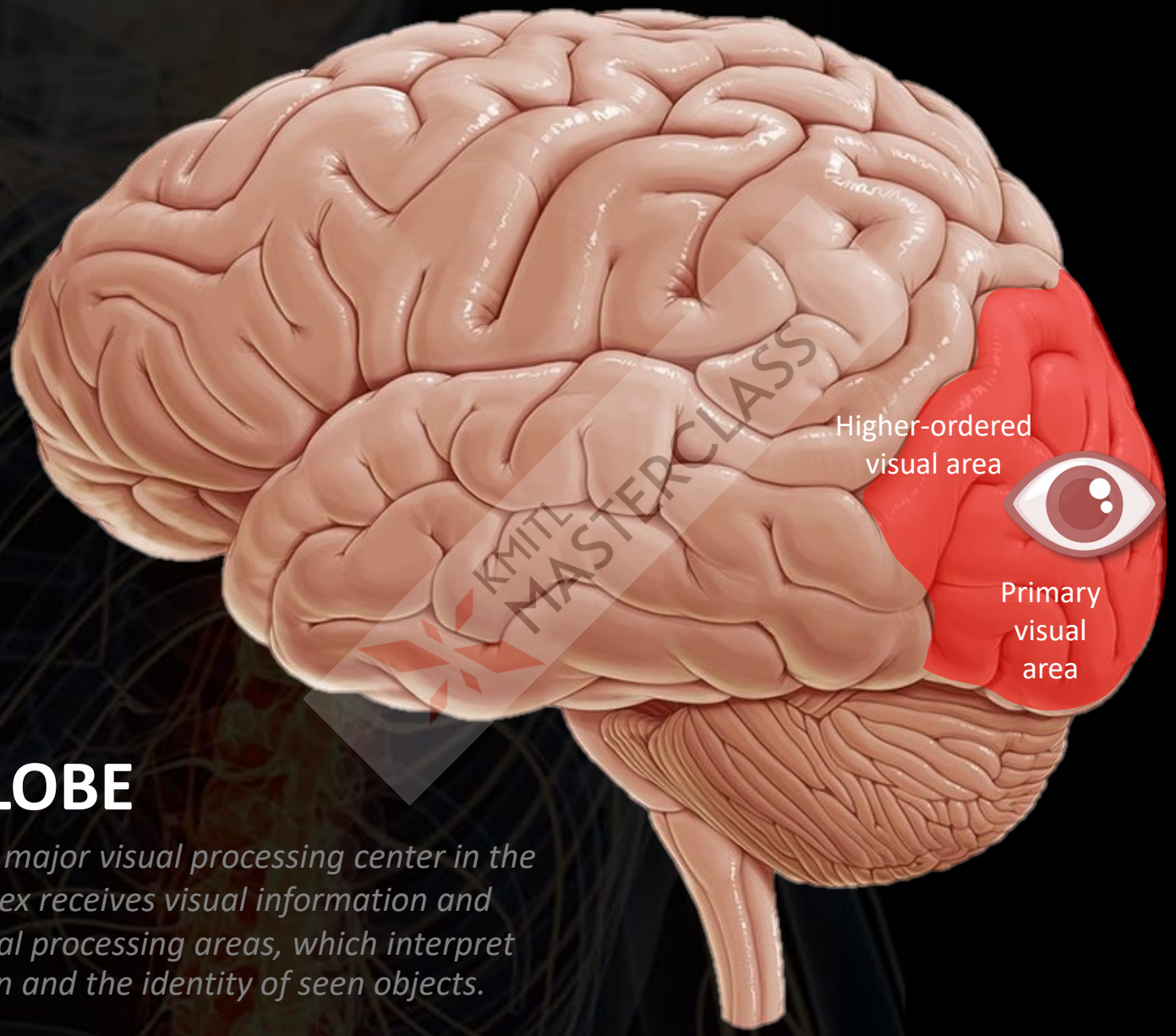
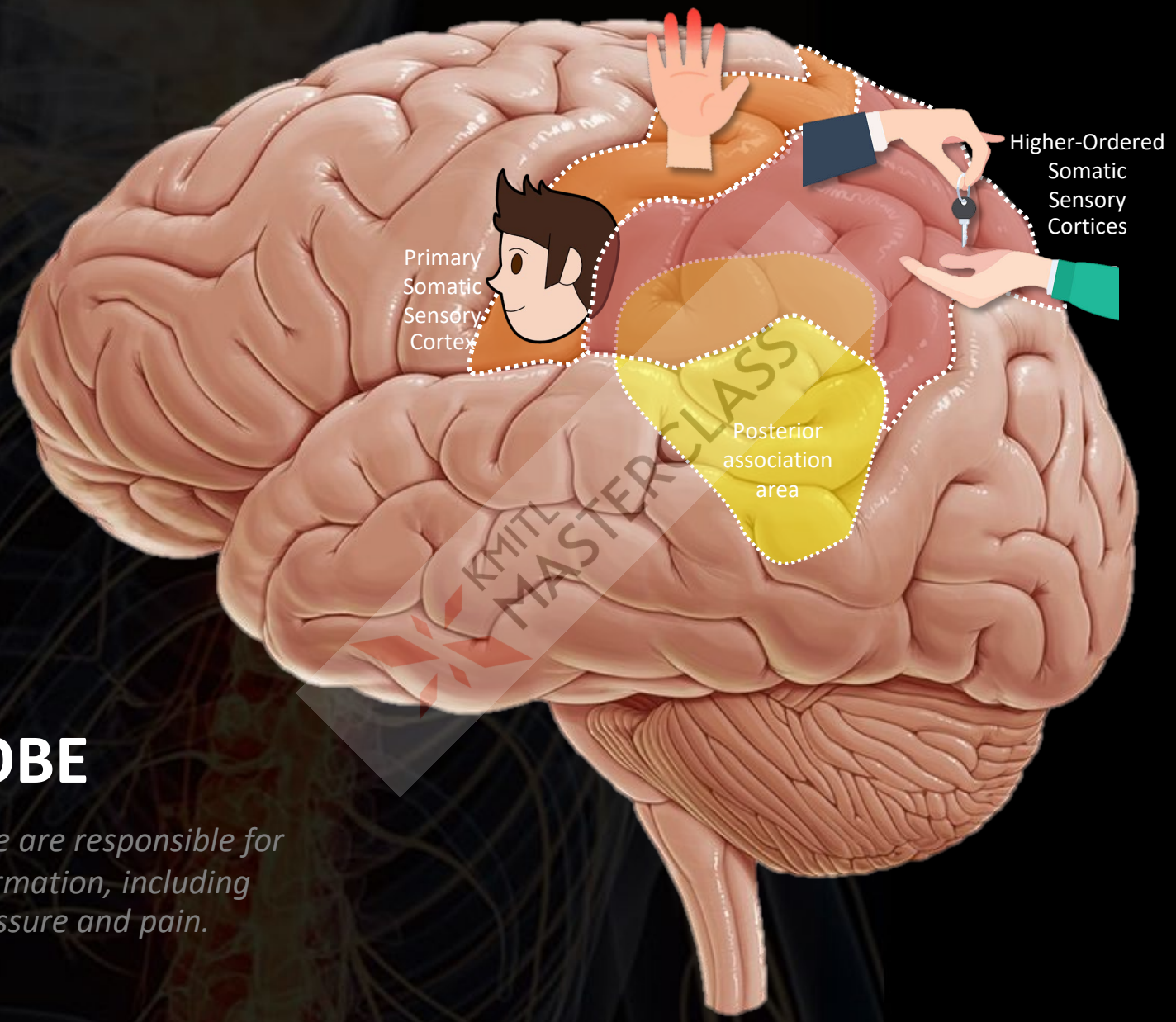


OCCIPITAL LOBE

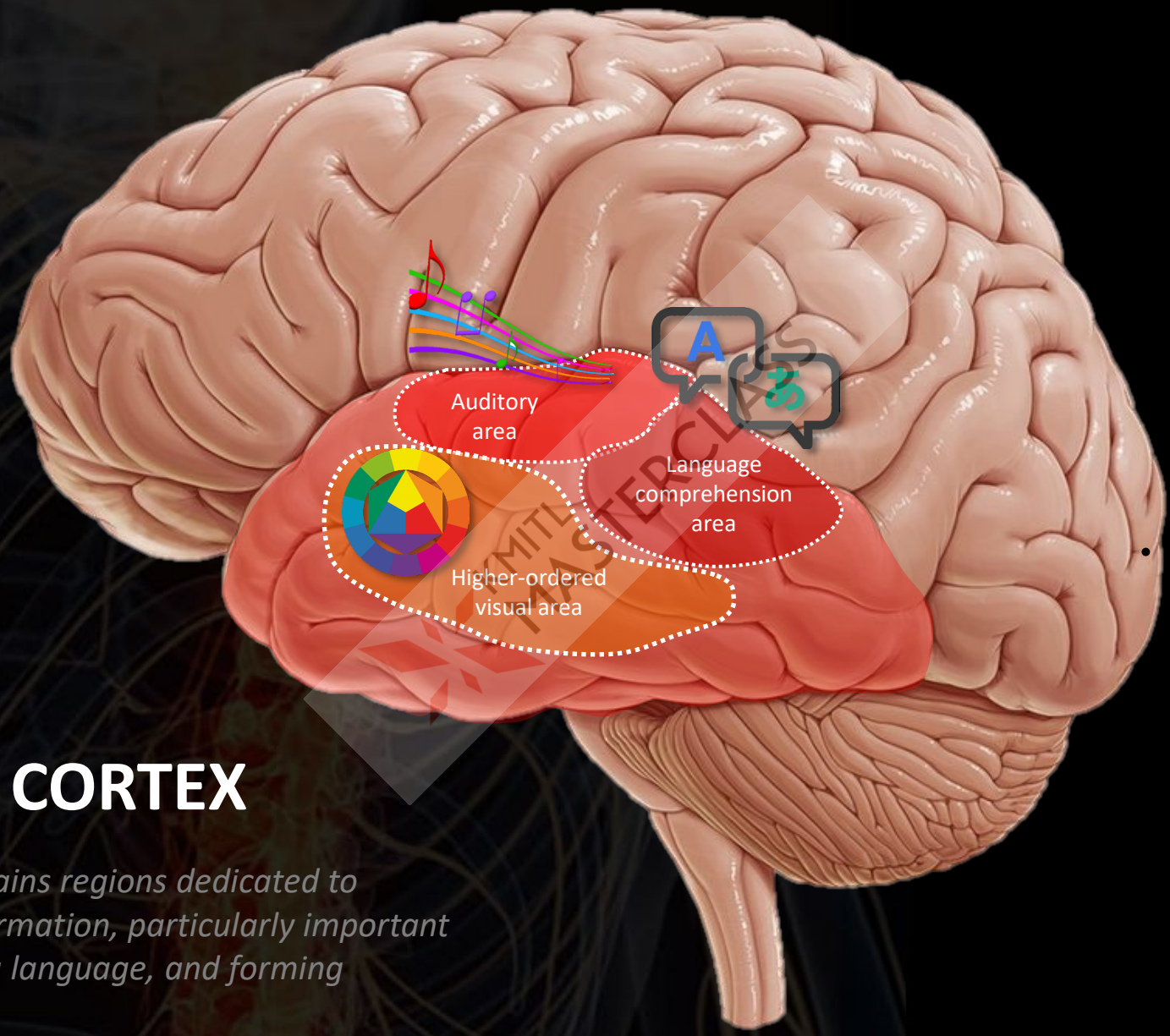
The occipital lobe is the major visual processing center in the brain. The 1º visual cortex receives visual information and relays to several 2º visual processing areas, which interpret depth, distance, location and the identity of seen objects.



PARIETAL LOBE

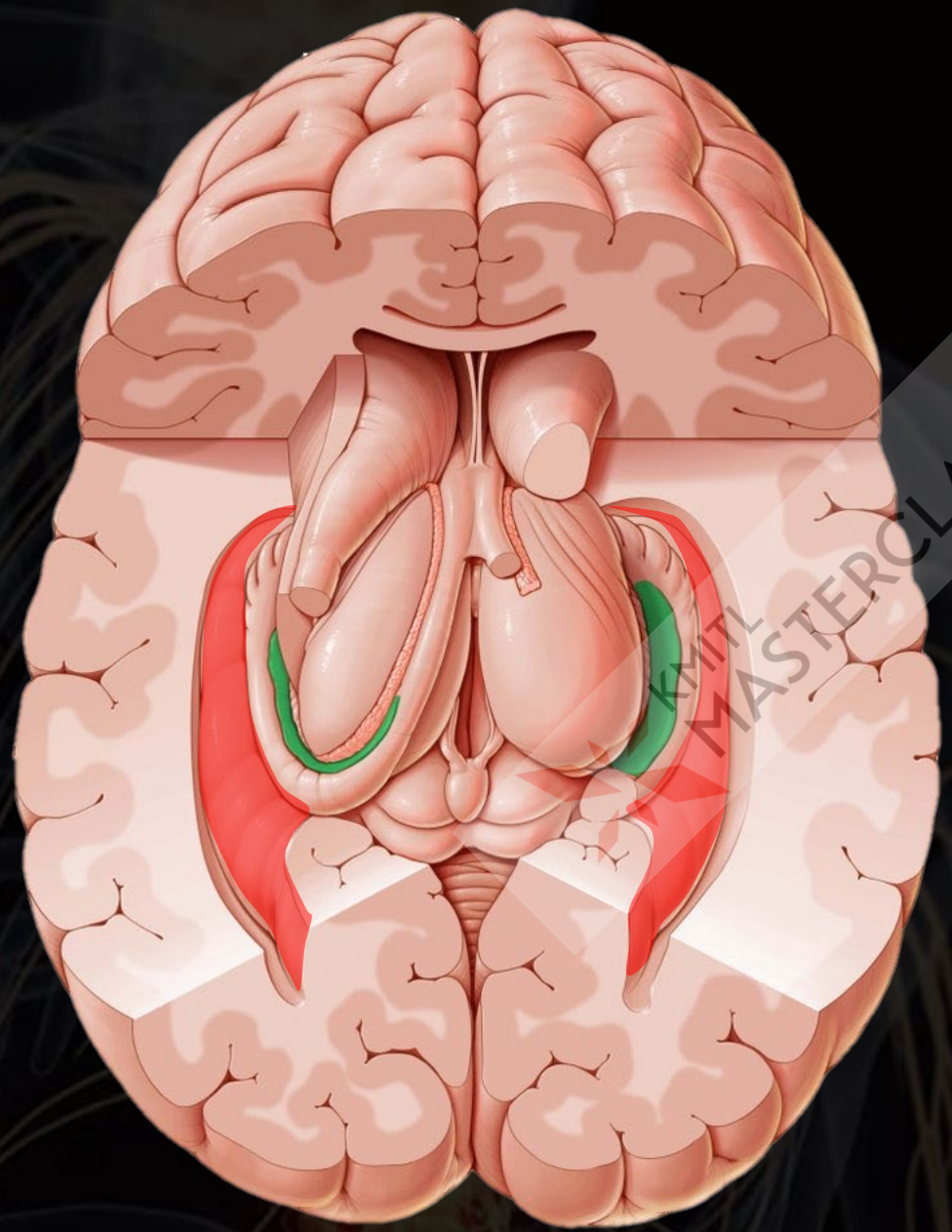
Areas in the parietal lobe are responsible for integrating sensory information, including touch, temperature, pressure and pain.

SOMATIC SENSATION – SOMATOTROPIC MAP



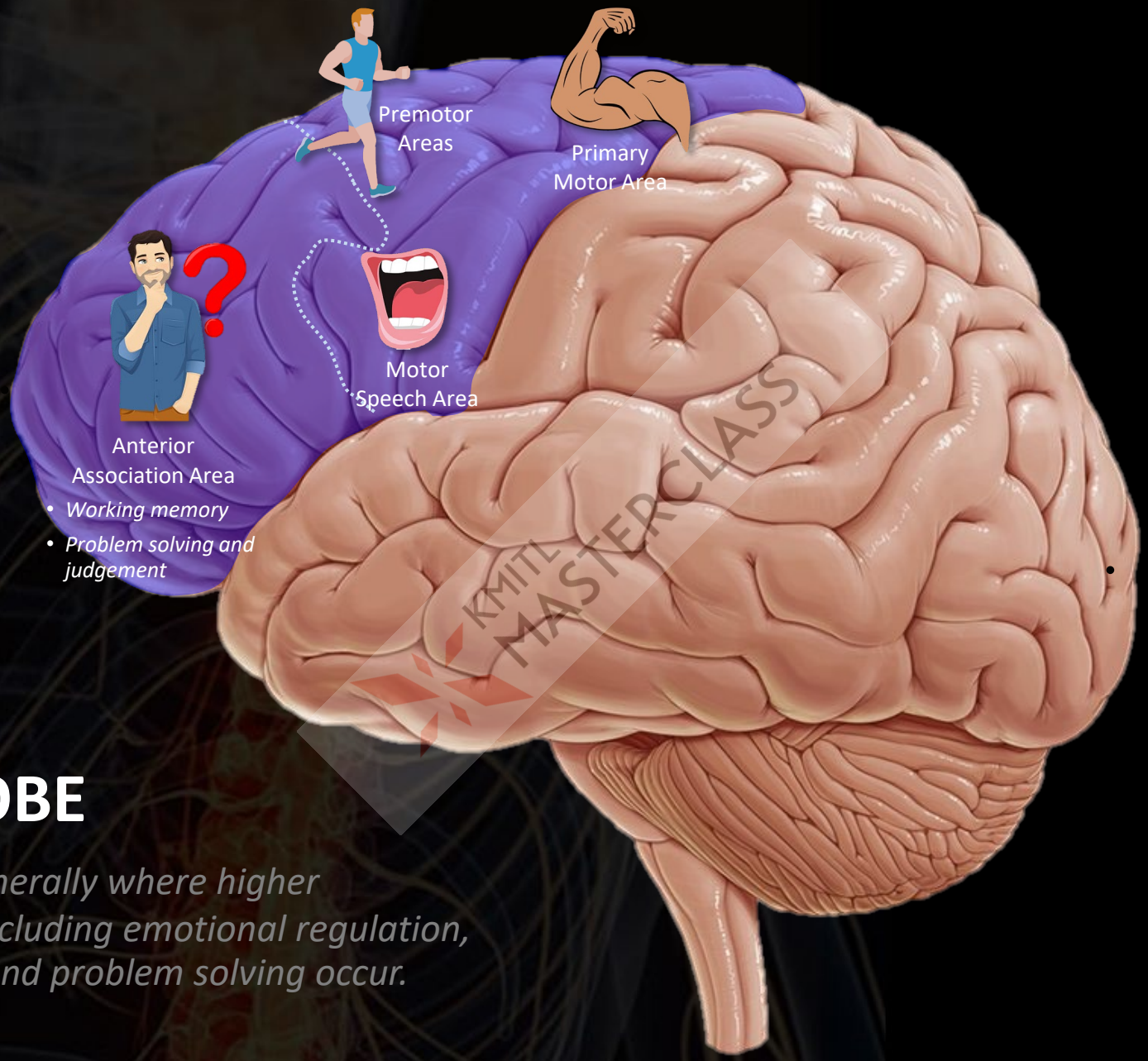
TEMPORAL CORTEX

The temporal lobe contains regions dedicated to processing sensory information, particularly important for hearing, recognizing language, and forming memories.



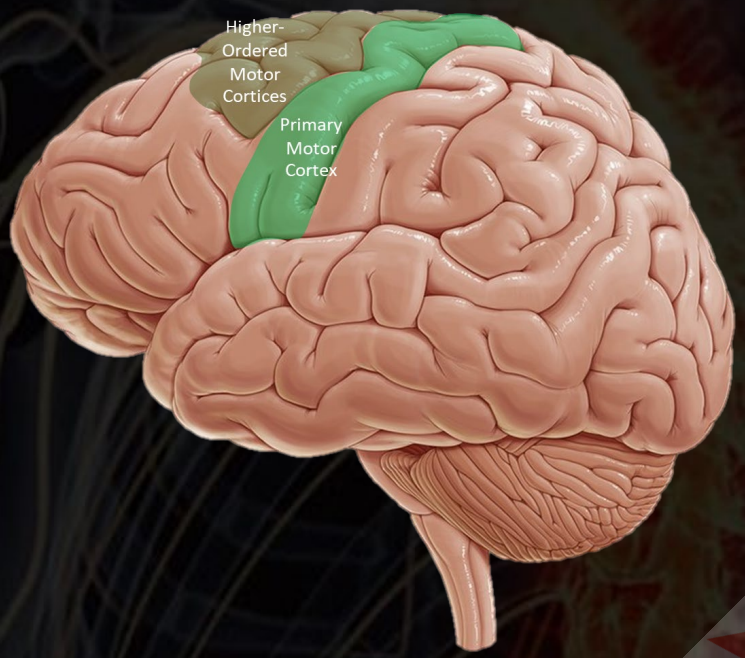
Hippocampus

- Memory formation
- Emotions
- Motivation



FRONTAL LOBE

The frontal lobe is generally where higher executive functions including emotional regulation, planning, reasoning and problem solving occur.

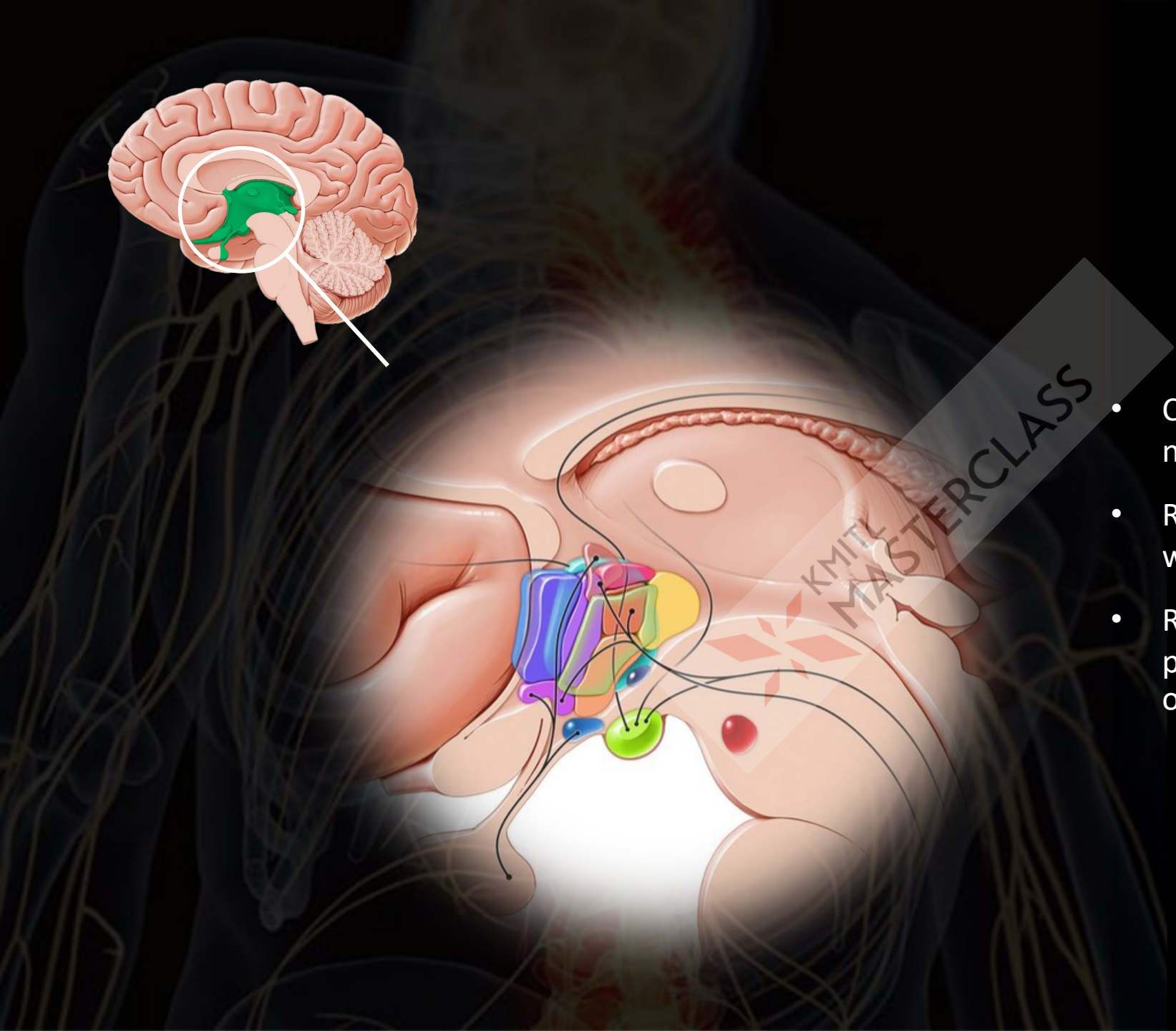


PRECENTRAL GYRUS

Primary Motor Area

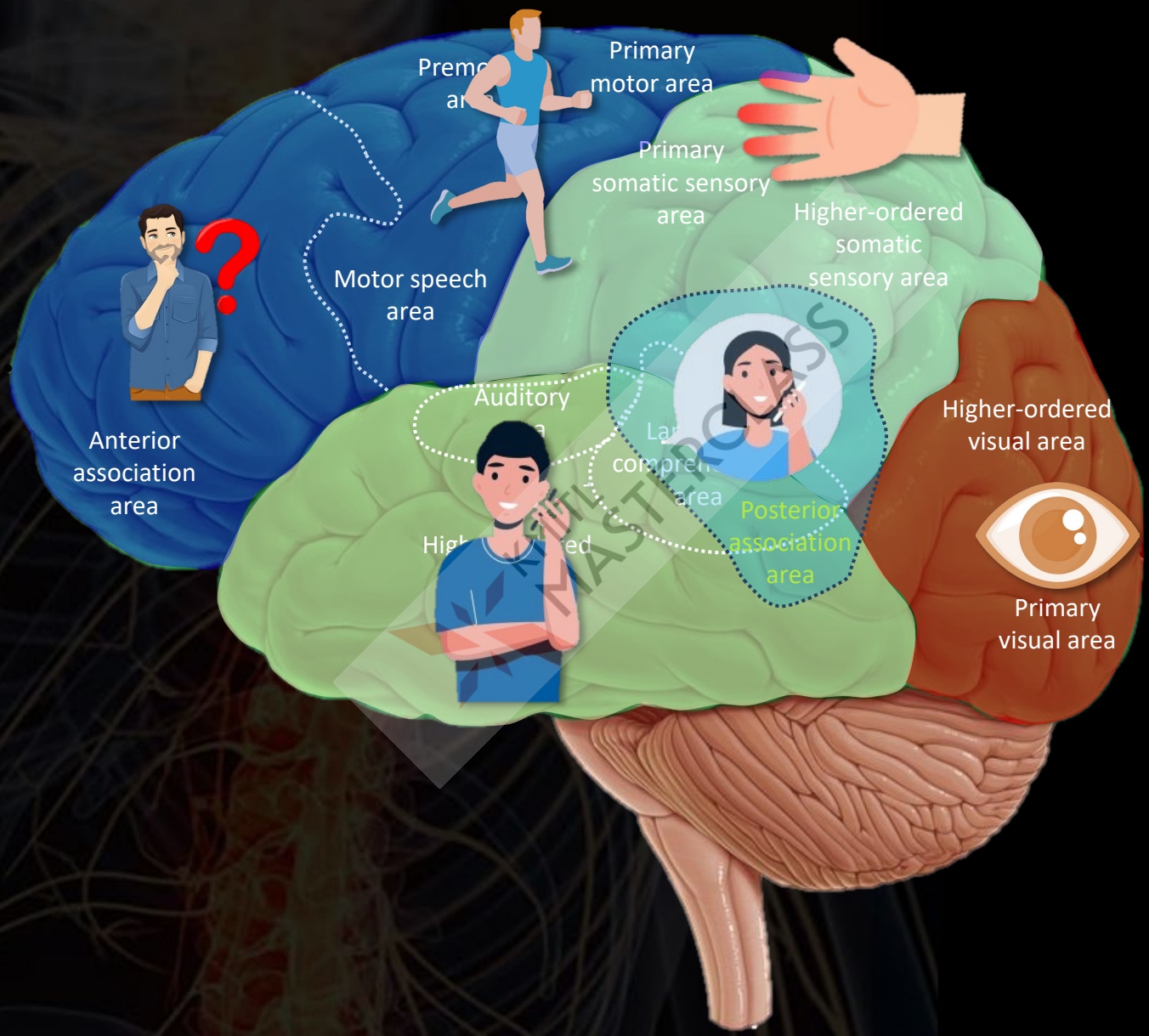
The Limbic System

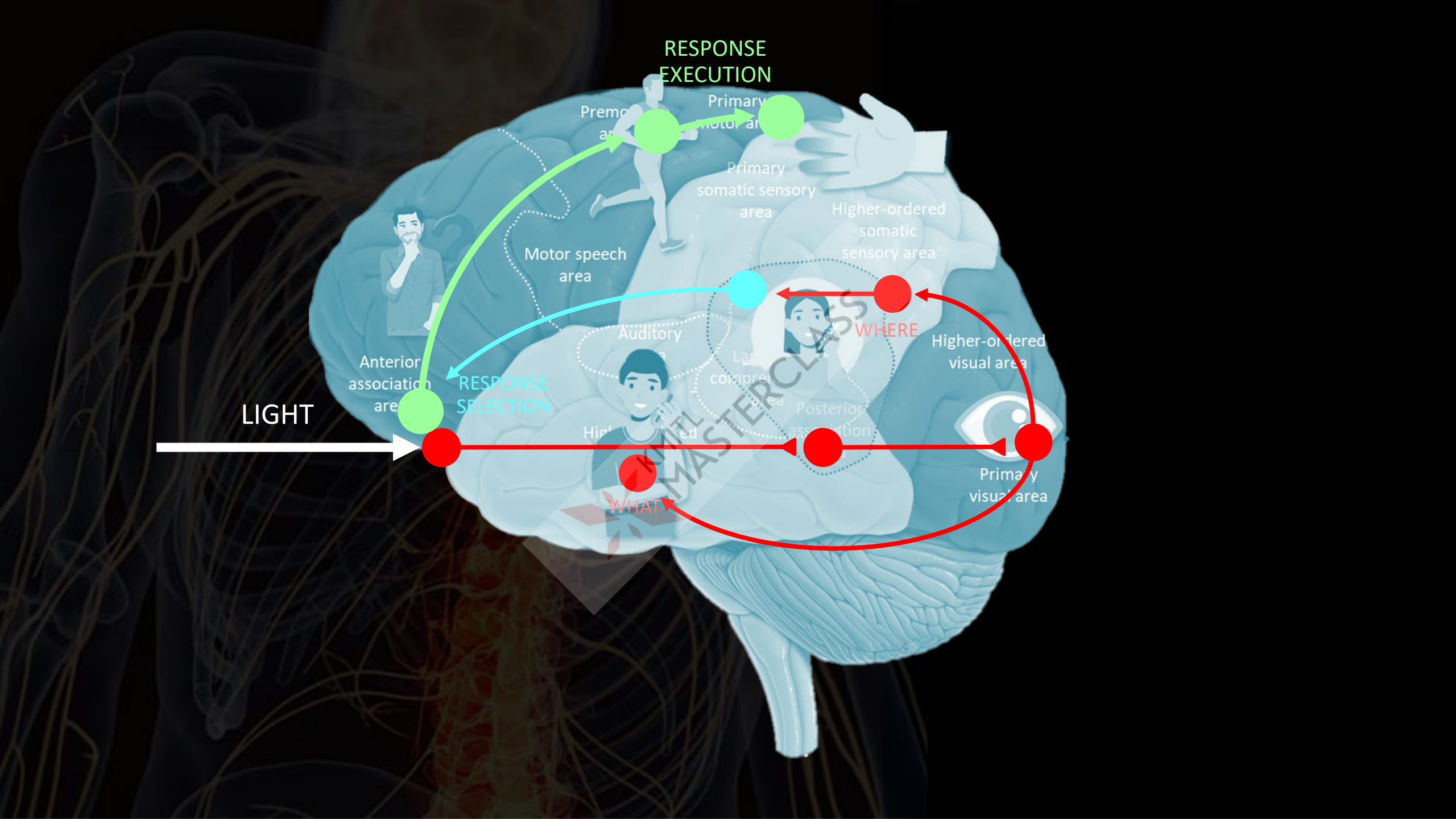
- Include cerebral and diencephalon structures (e.g. hypothalamus, anterior thalamic nuclei)
- Mediates emotional response; involved in memory formation

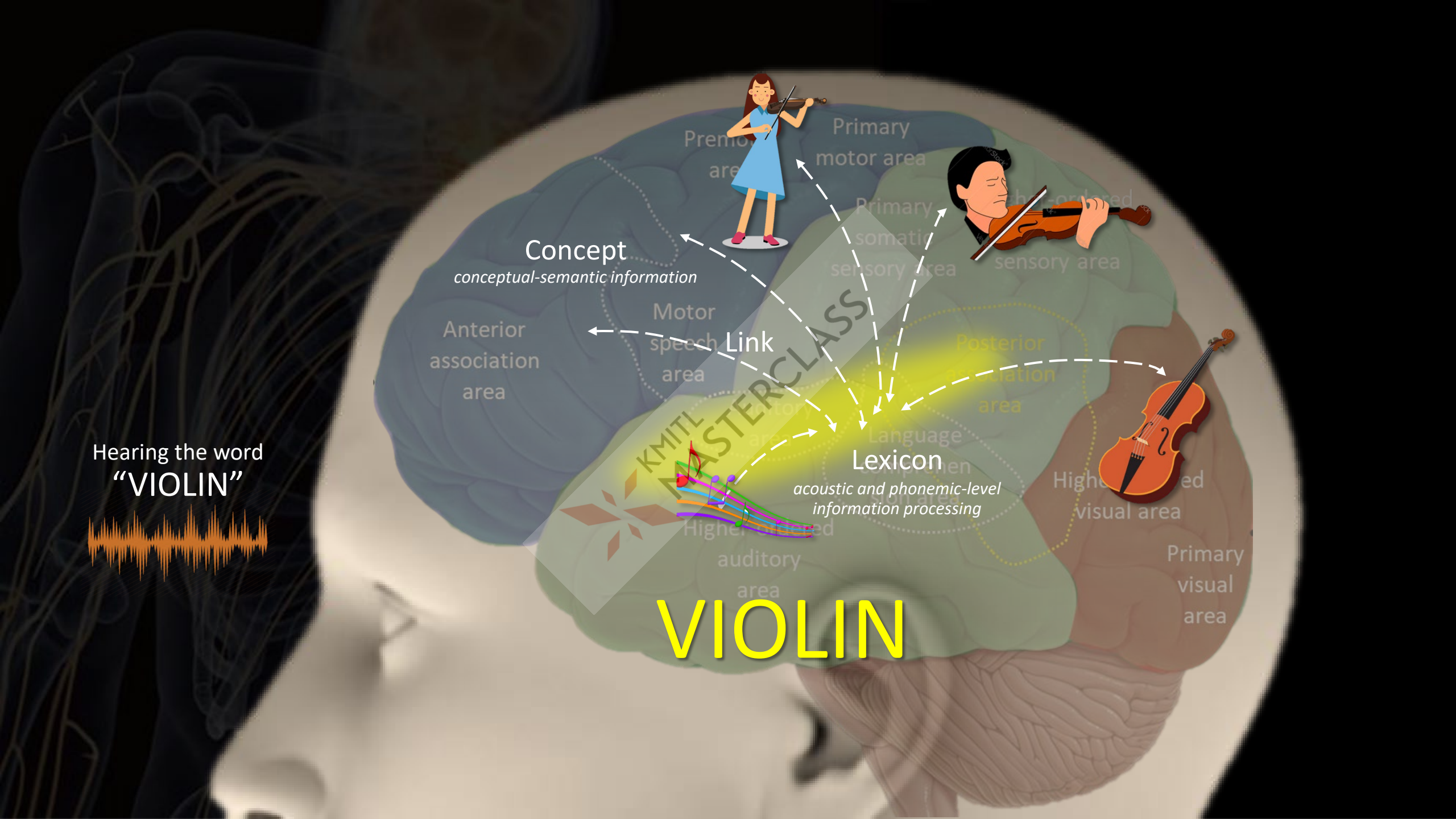


Hypothalamus

- Chief integration center of an autonomic nervous system
- Regulates body temperature, food intake water balance, and thirst
- Regulates hormonal output of anterior pituitary gland and acts as an endocrine organ (producing ADH and oxytocin)


Premo
ar
Primary
motor area
Primary
somatic sensory
area
Higher-ordered
somatic
sensory area
Motor speech
area
Anterior
association
area
Auditory
Lar
compren
area
Posterior
association
area
Higher-ordered
visual area
Primary
visual area


RESPONSE
EXECUTION
Primary somatic sensory area
Higher-ordered somatic sensory area
Motor speech area
Auditory
WHERE
Higher-ordered visual area
Anterior association area
RESPONSE
SELECTION
LIGHT
WHAT
Primary visual area


Hearing the word
“VIOLIN”
Concept
conceptual-semantic information
Link
Lexicon
acoustic and phonemic-level information processing
Primary motor area
Primary somatosensory area
Anterior association area
Motor speech area
Higher-ordered auditory area
Primary visual area
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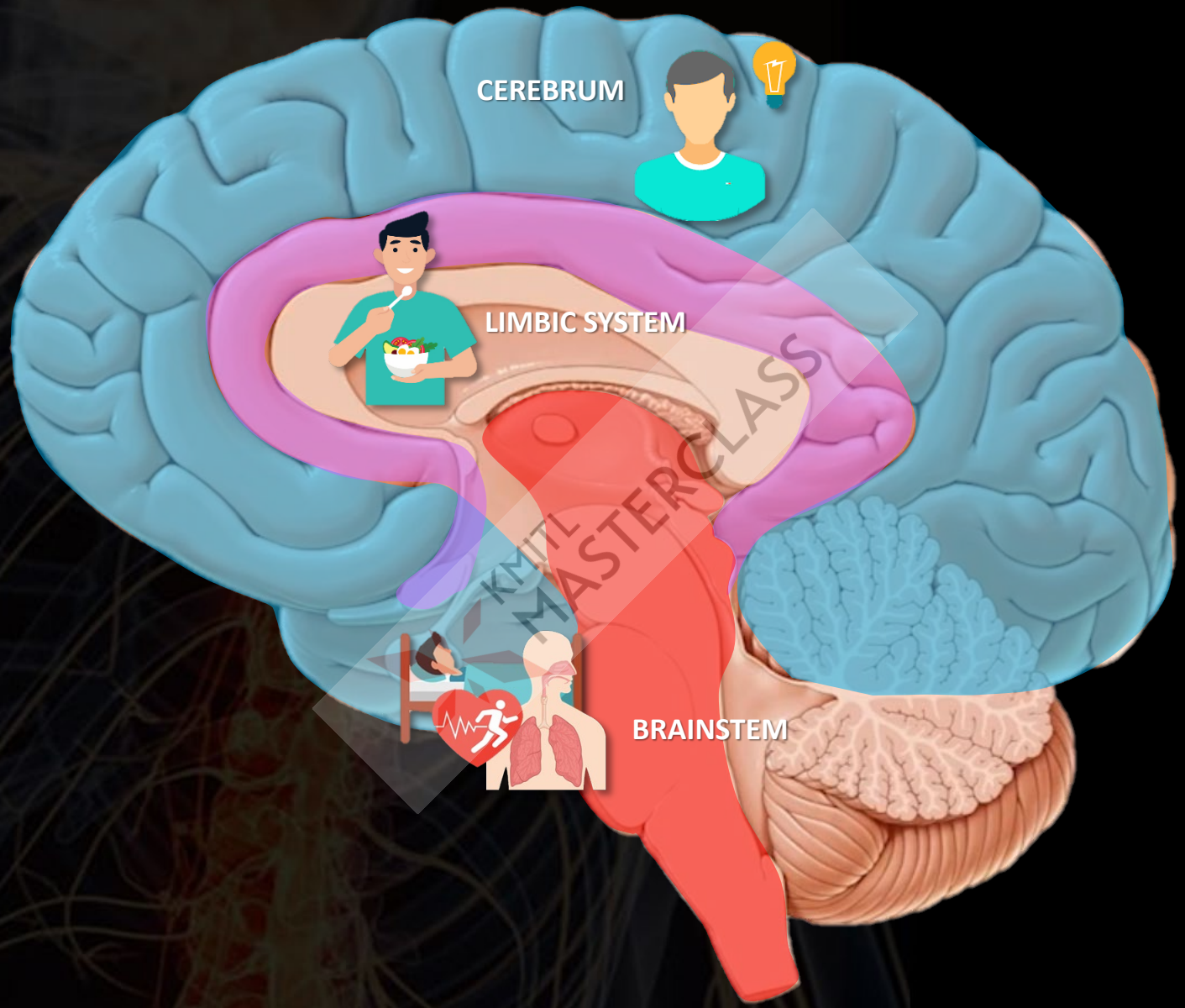
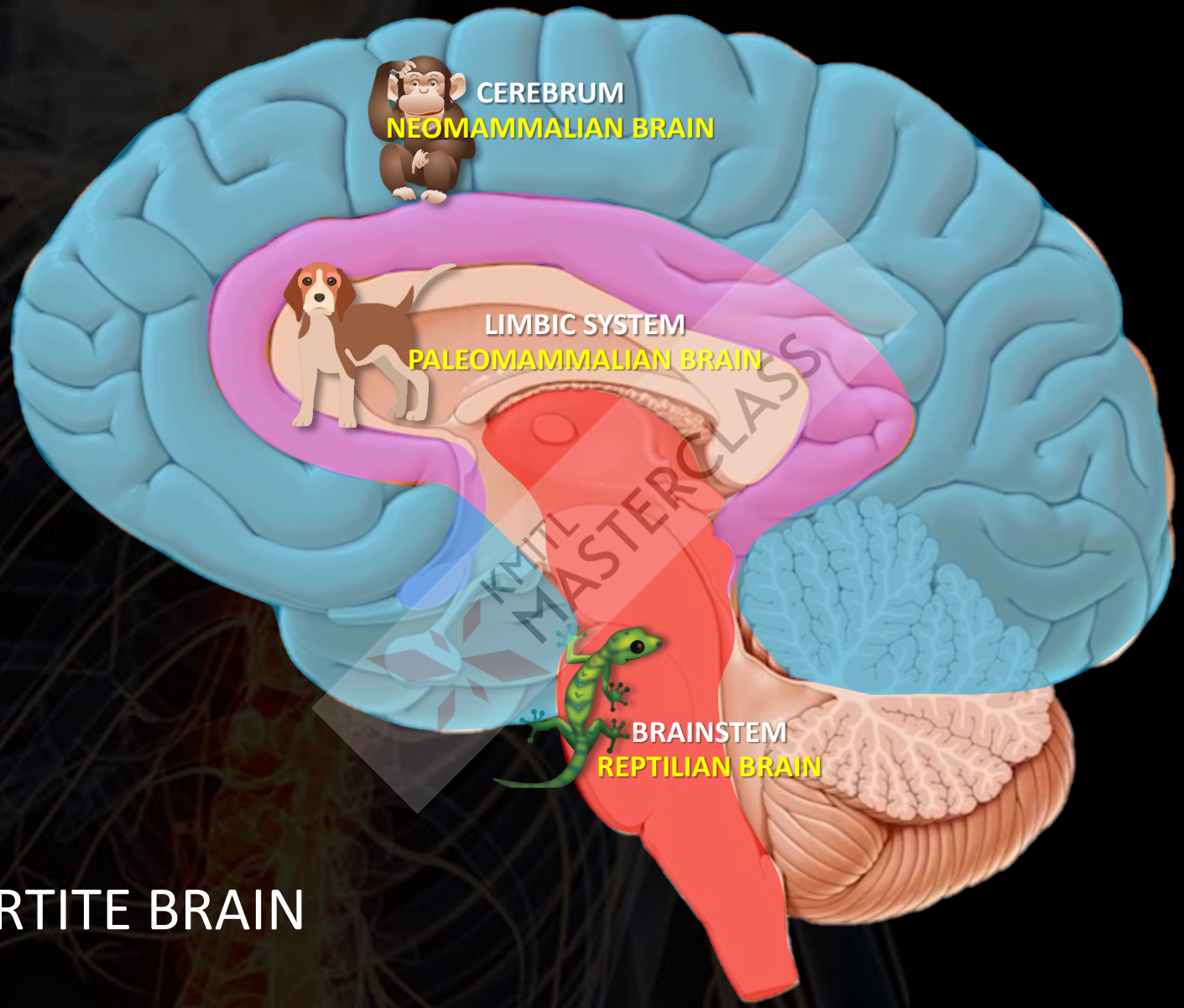
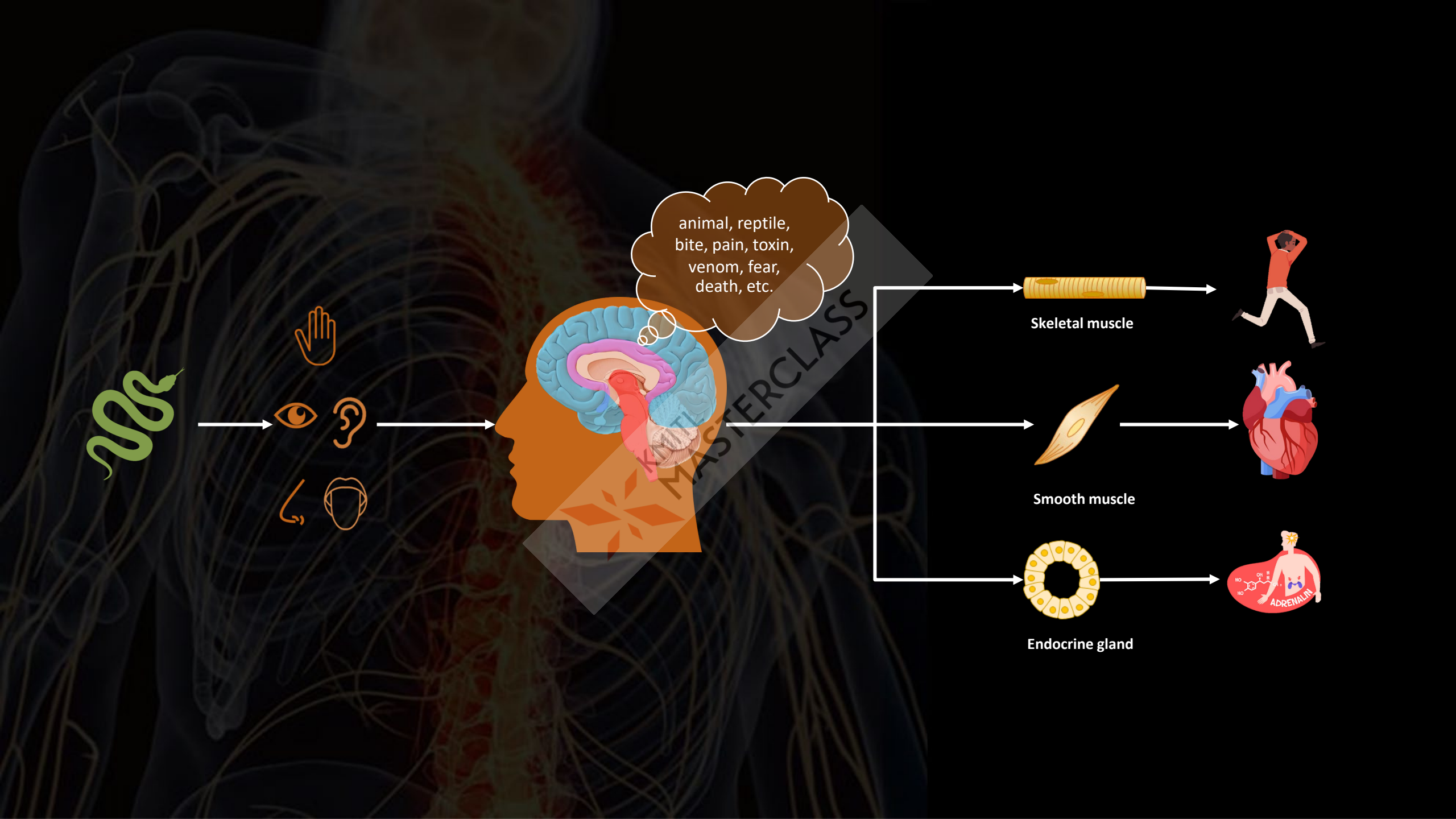
VIOLIN


CEREBRUM
LIMBIC SYSTEM
BRAINSTEM



TRIPARTITE BRAIN


animal, reptile, bite, pain, toxin, venom, fear, death, etc.
Skeletal muscle
Smooth muscle
Endocrine gland
ADRENALIN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BRAIN

THE HUMAN CPU