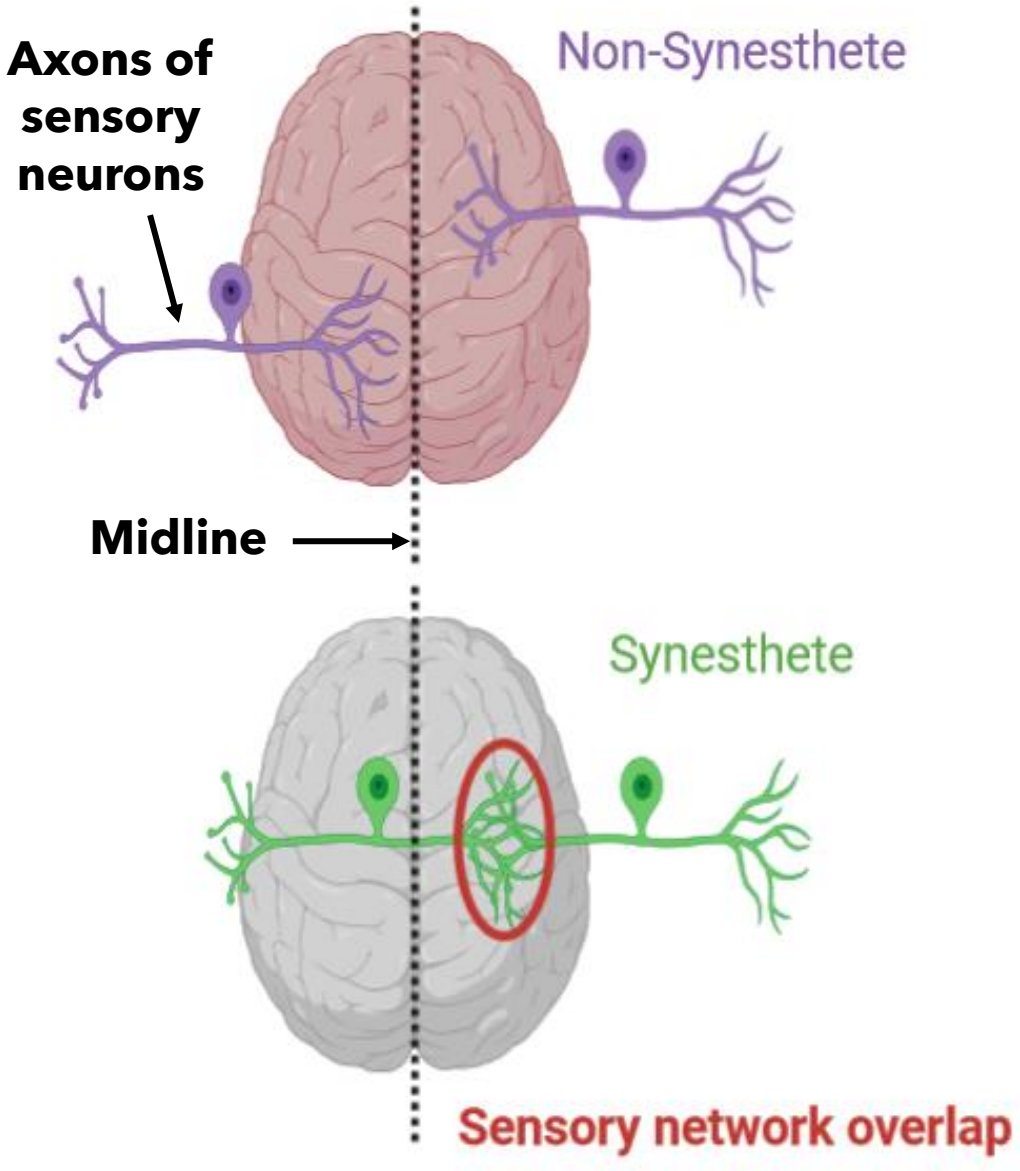
Synesthesia:
What if you could see music?

Olivia Steidl

Gen 564

What is synesthesia?



Synesthetes experience multiple senses simultaneously

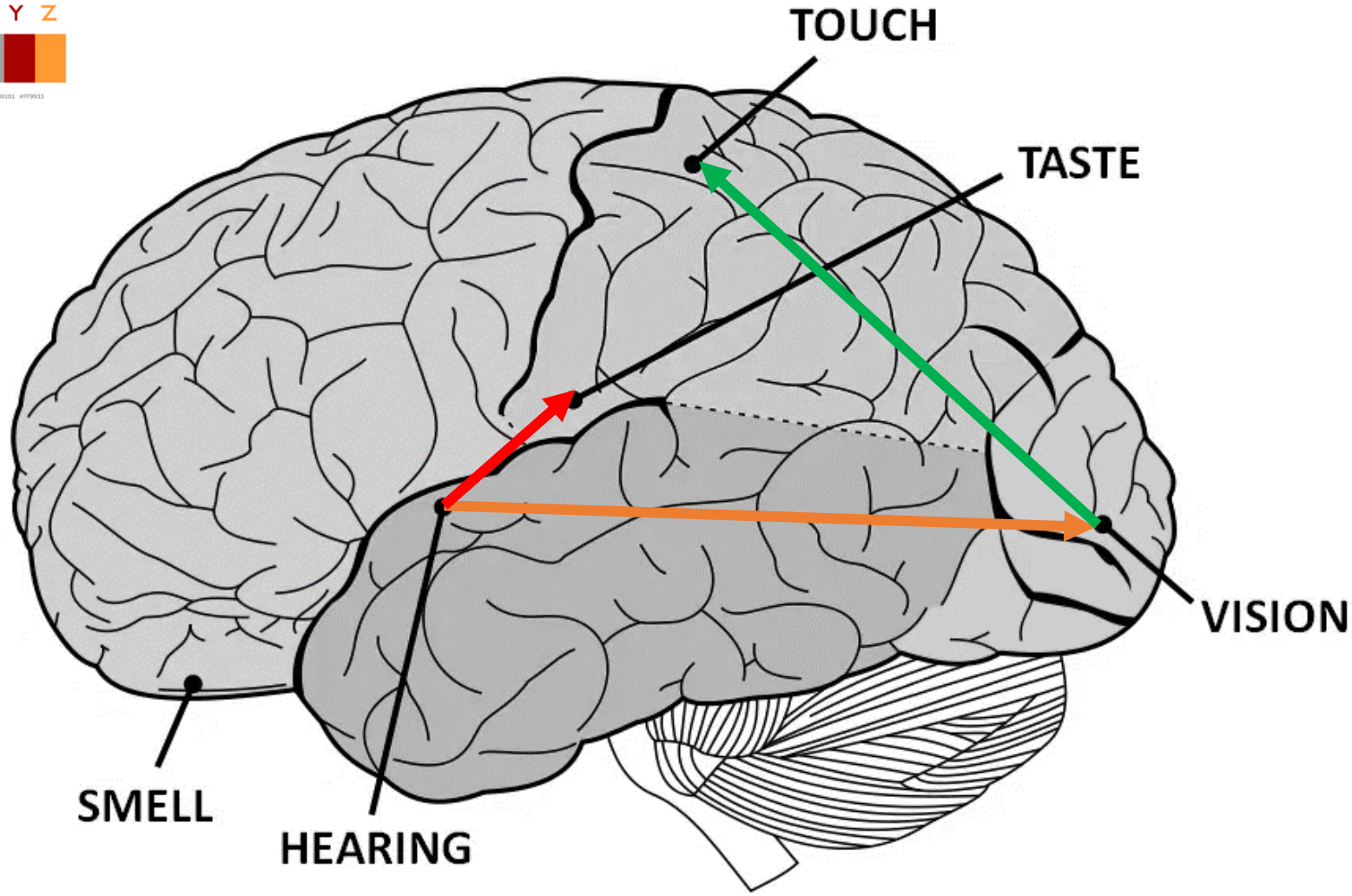
Grapheme-color

Sound-color

Mirror-touch

Lexical-gustatory

Sequence-spatial

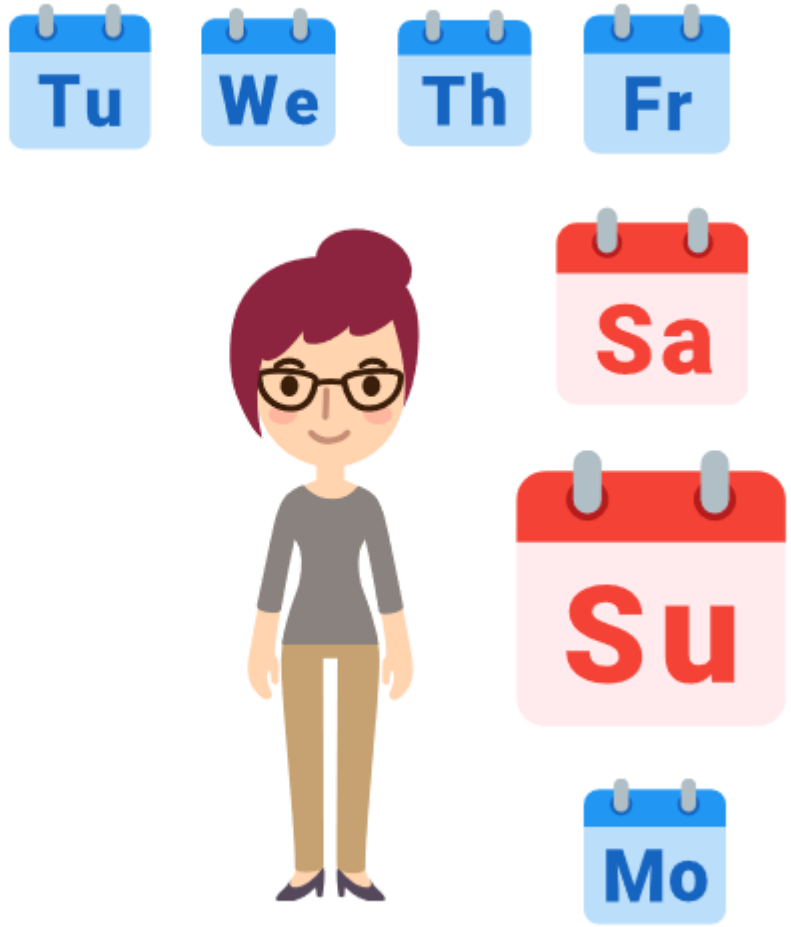


Synesthesia impacts learning

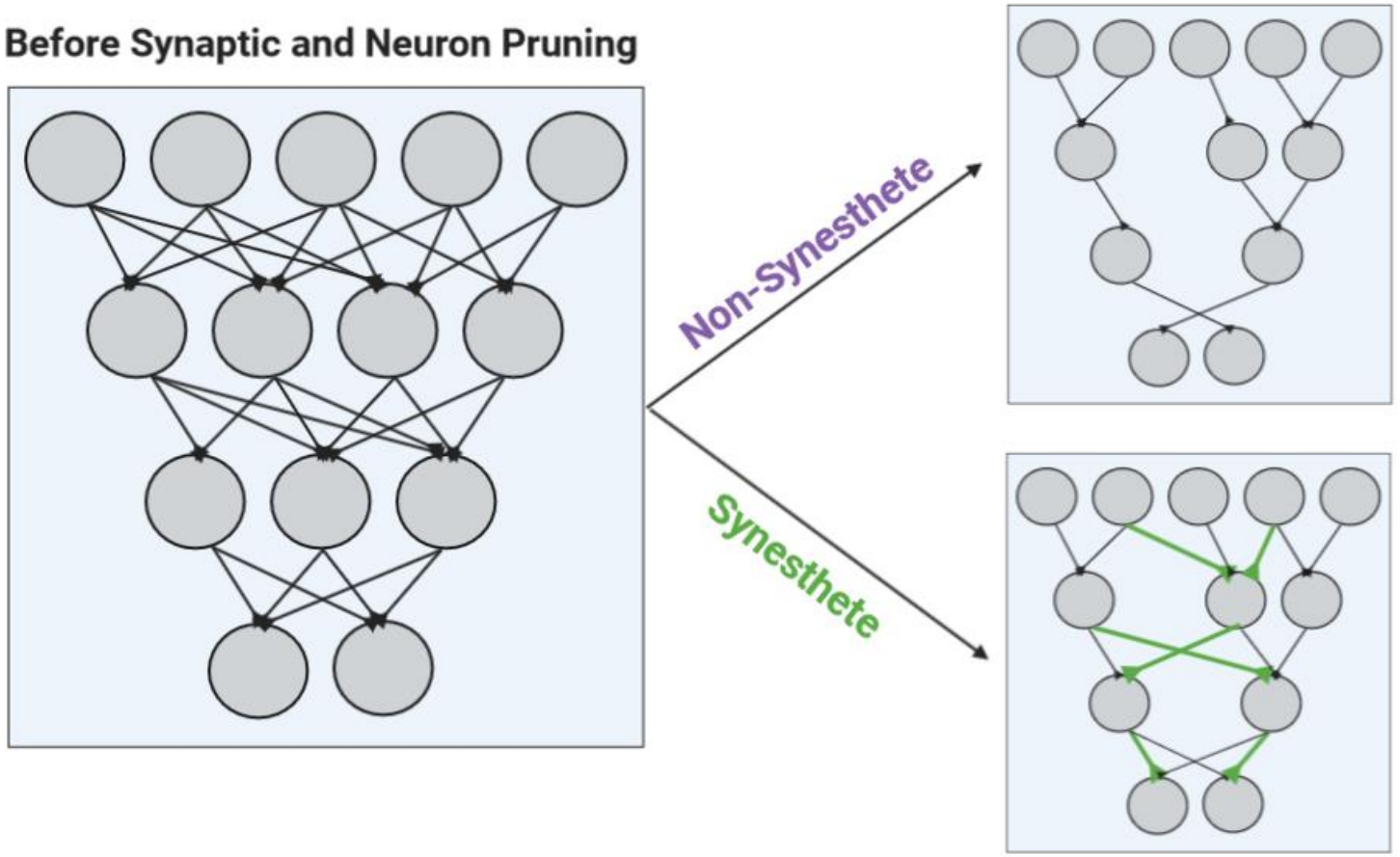
rain

moon

wing



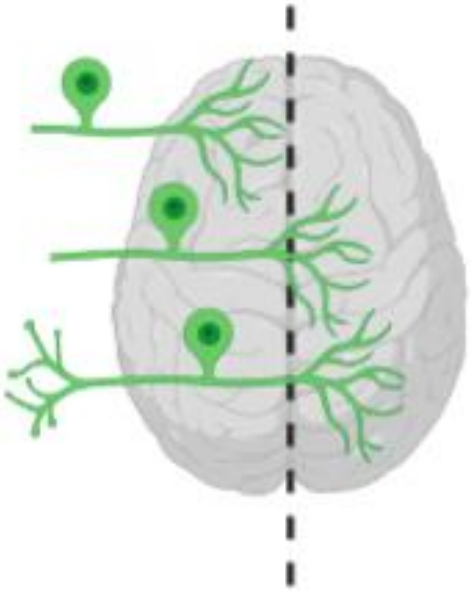
What causes synesthesia?



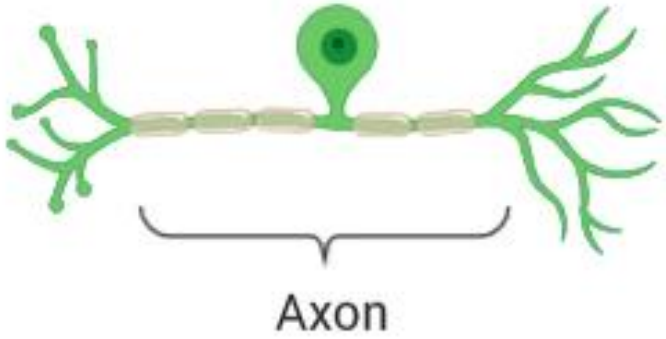
One theory is errant synaptic pruning

ROBO3 is mutated in synesthesia

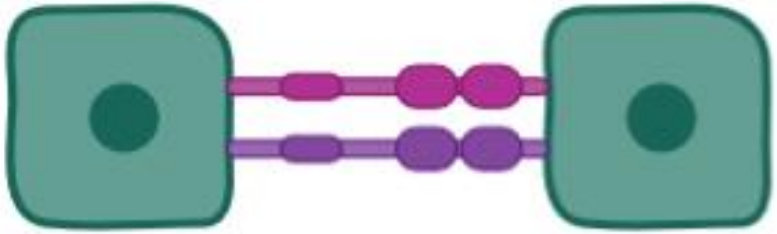
Biological Process



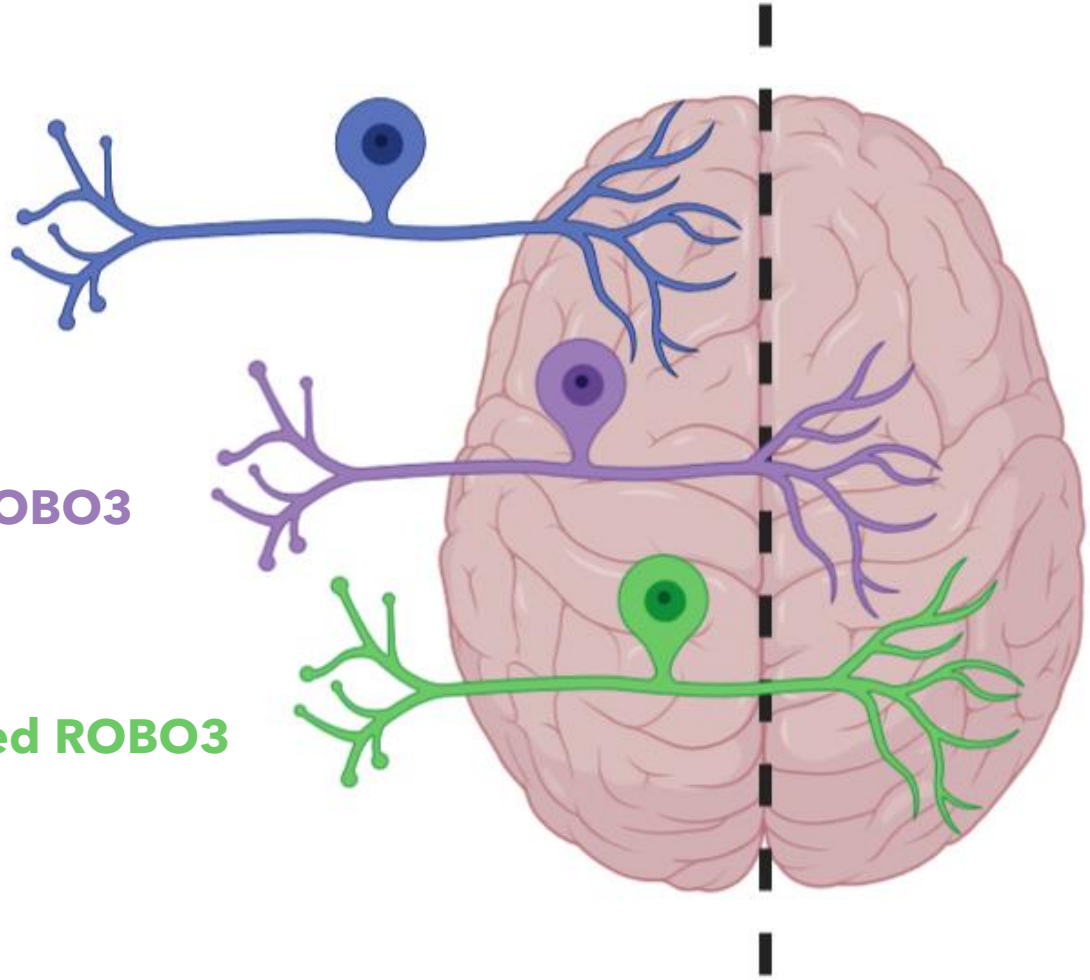
Cellular Component



Molecular Function

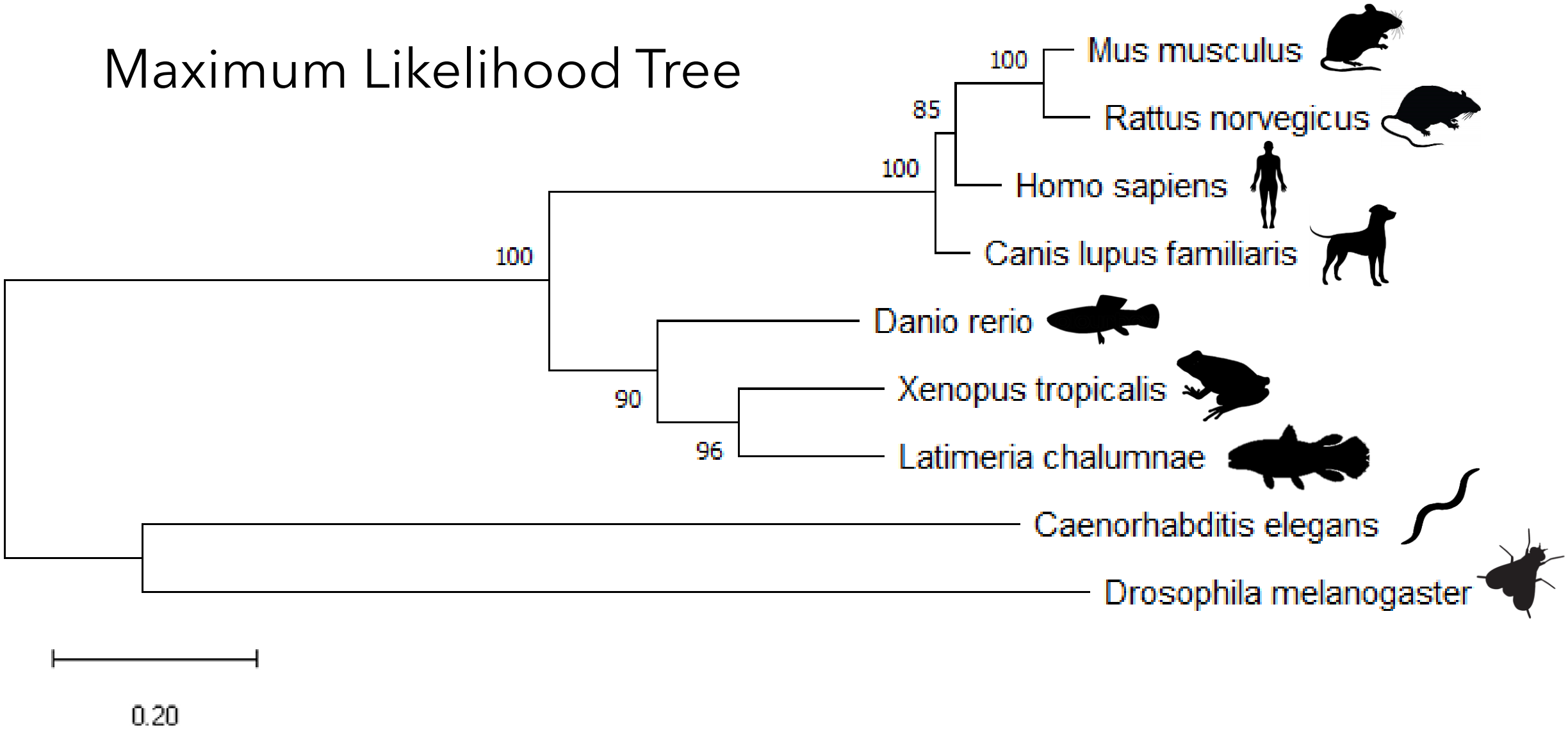


ROBO3 is involved in axon guidance



ROBO3 homologs have conserved domain types

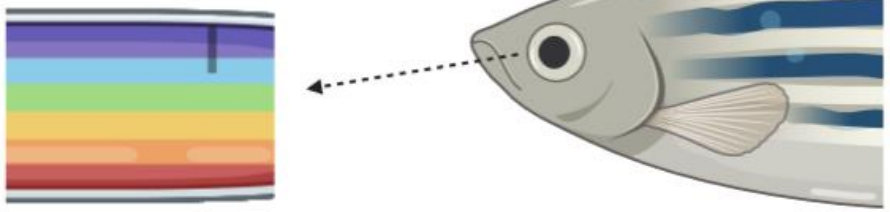
ROBO3 homologs are related through evolution



What is the gap in knowledge?

ROBO3

Color perception

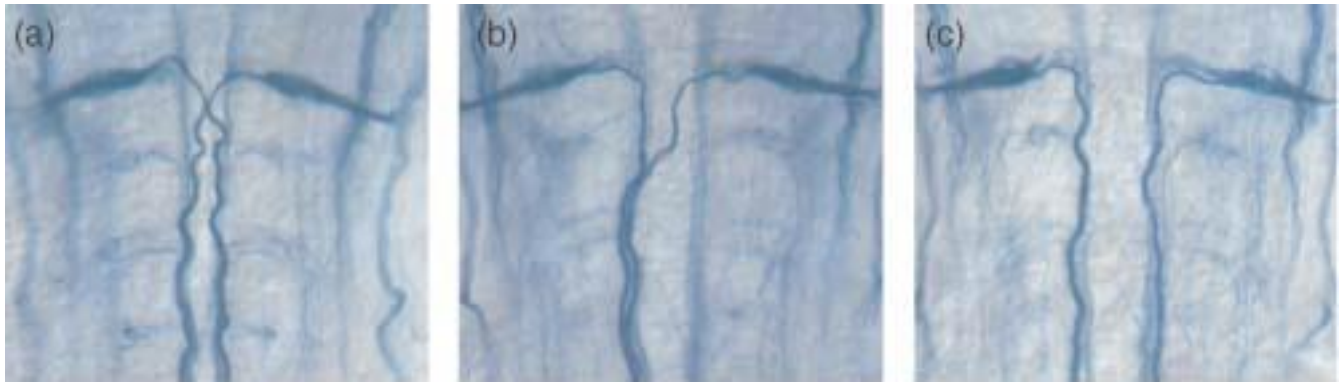


Learning?

Zebrafish as a ROBO3 phenotype model

Zebrafish (Danio rerio) brain

Unmutated | **Single ROBO3 Mutation** | **Double ROBO3 Mutation**



Axons attempting to cross the midline in the zebrafish brain

Transparent nervous systems, color perception, and prior use in learning studies

Burgess, 2009

Specific Aims

Goal: To explore how ROBO3 mutations impact learning through color perception

Aim #1: Identify specific **protein domain regions** within ROBO3 that contribute to color perception.

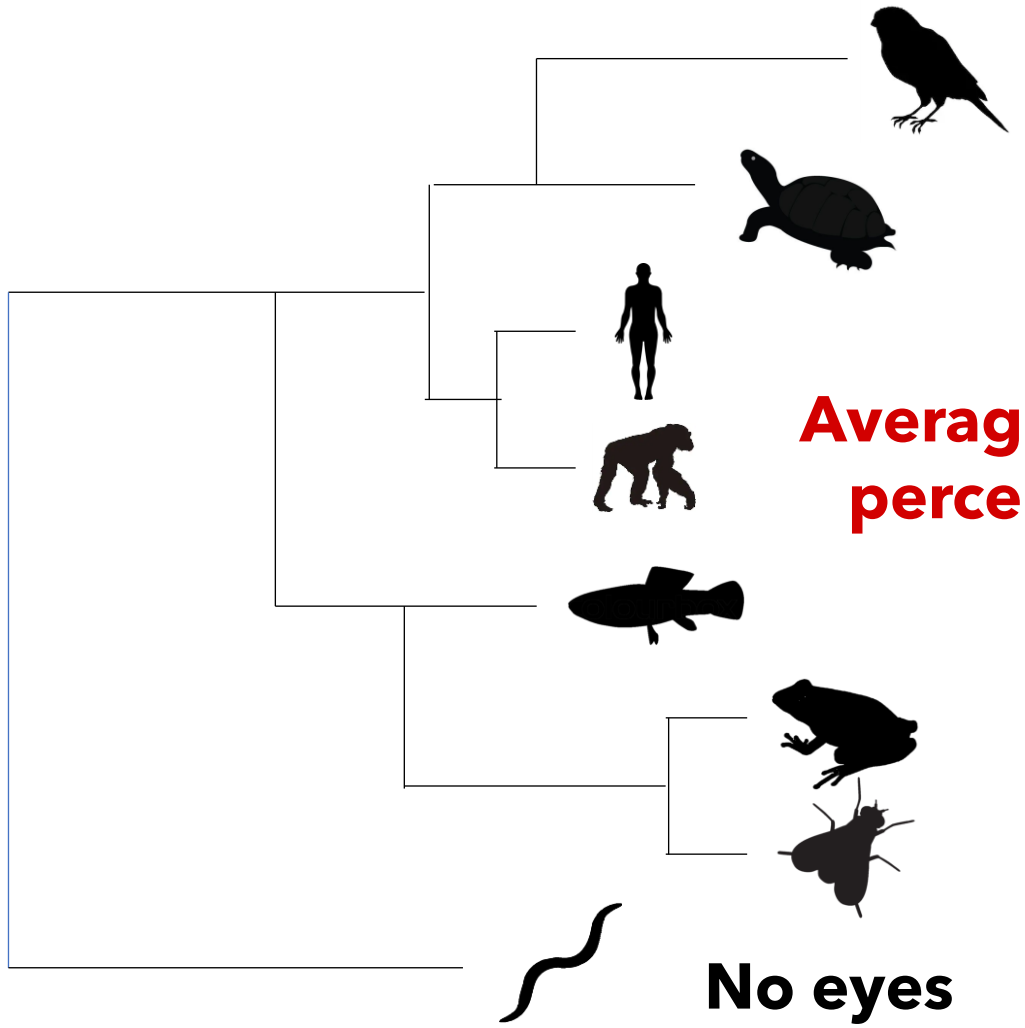
Aim #2: Identify **differential gene expression patterns** in ROBO3 mutants.

Aim #3: Identify new **protein interactions** between ROBO3 and proteins involved in color perception and learning.

Aim 1: Protein Domains

Then, align with Clustal-W

Aim 1: Protein Domains



Enhanced color perception

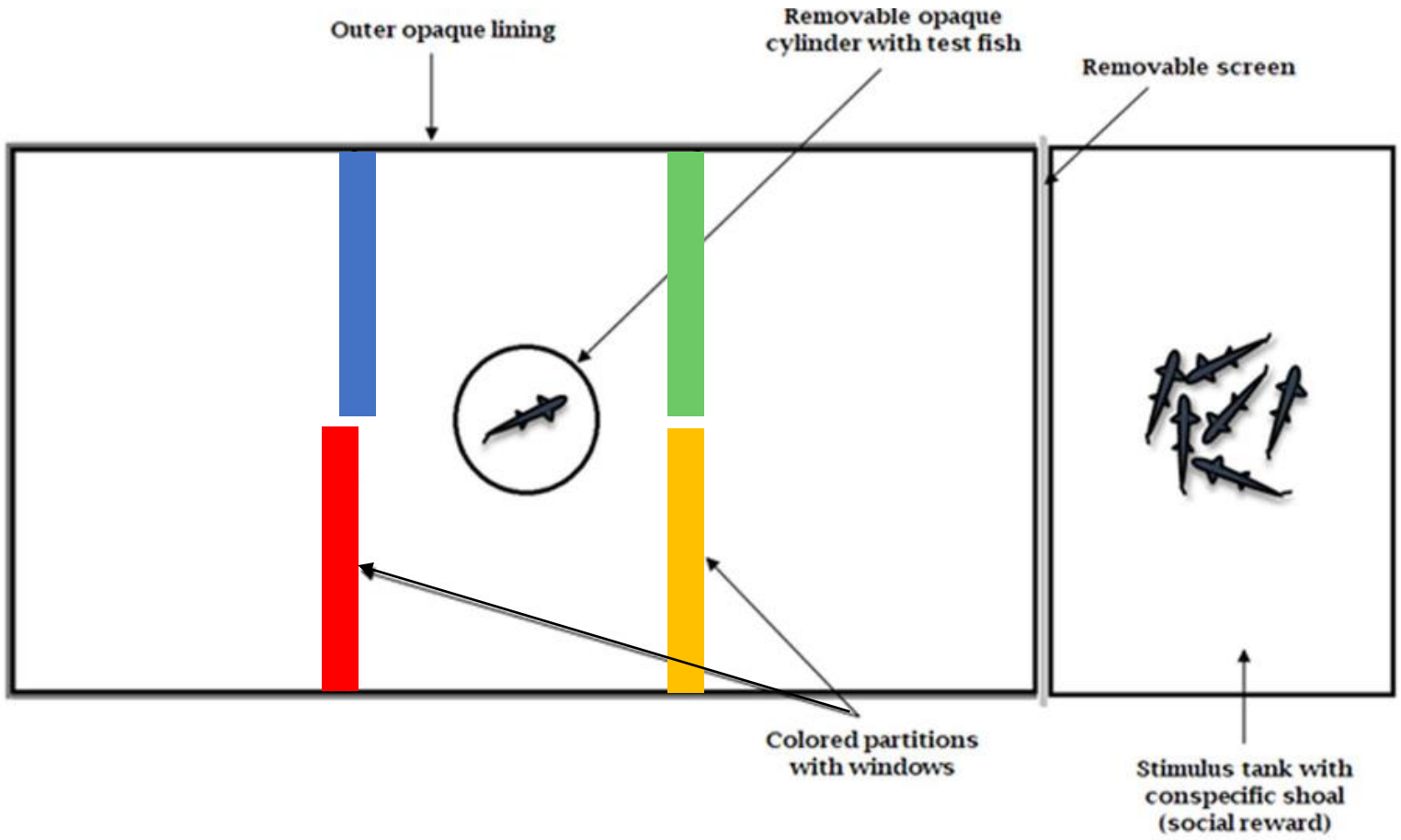
Average color perception

Below average color perception

No eyes

Identify domain SNPs that generate similar trees

Aim 1: Protein Domains



mutant

WT

Roy, et. al 2019

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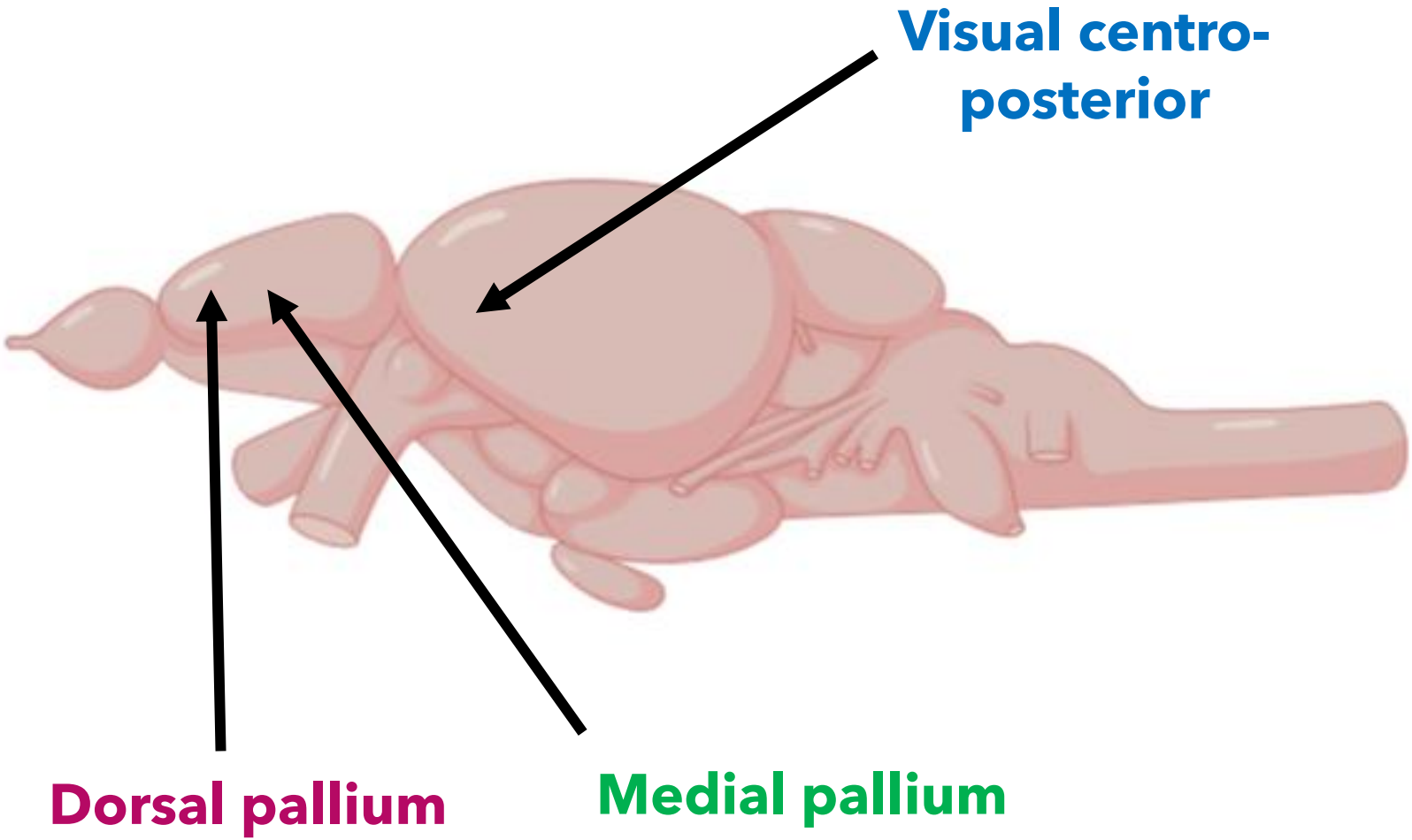
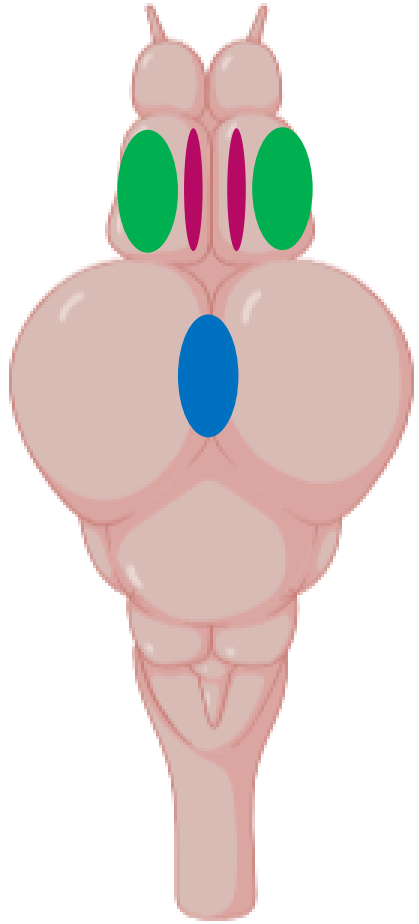
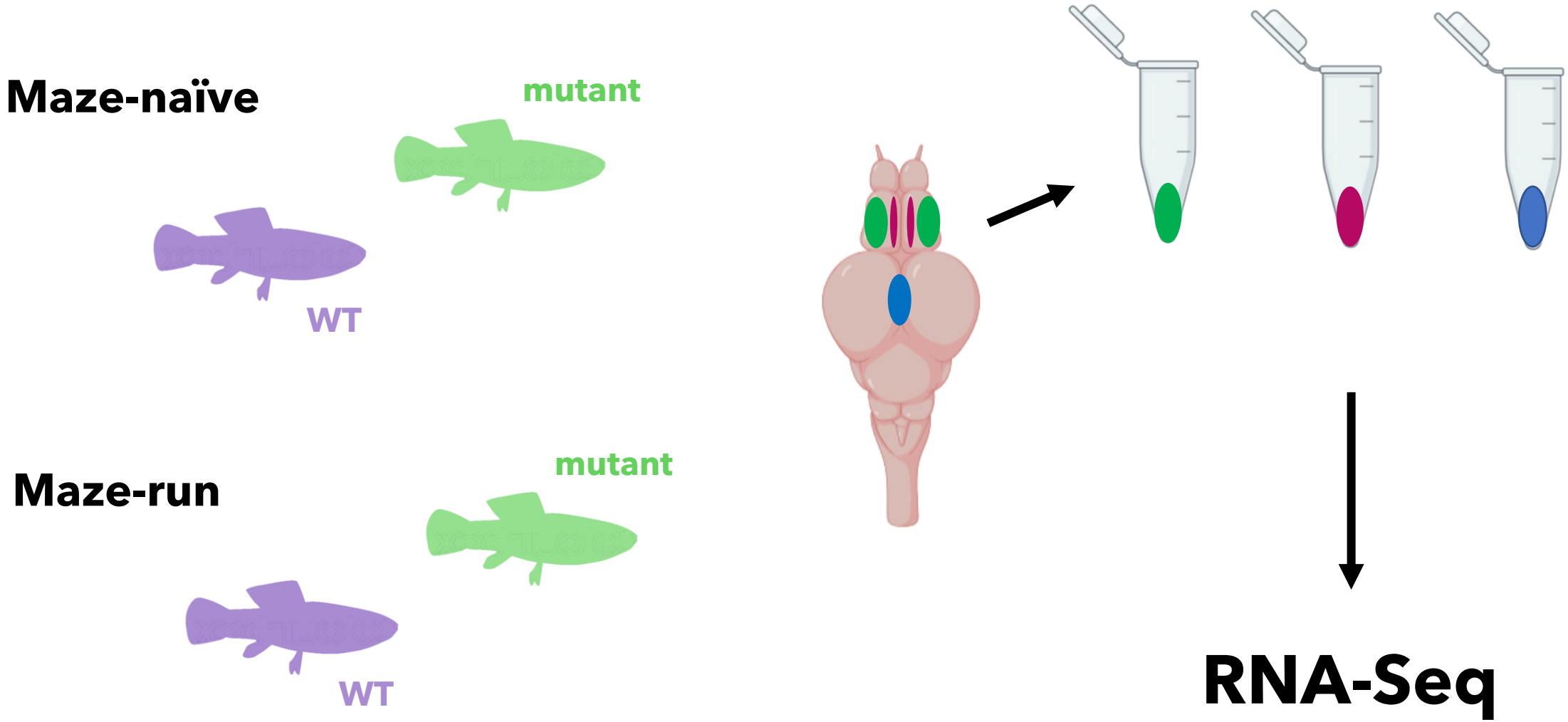
Aim 2: Gene Expression





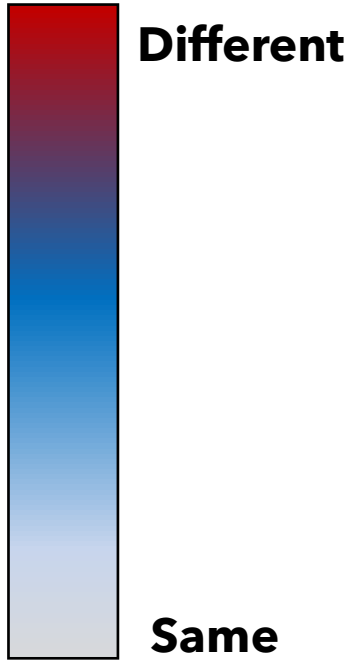
Aim 2: Gene Expression



Aim 2: Gene Expression

GO Terms

	Control WT maze-naïve	ROBO3 mutant maze-naïve	WT maze-run	ROBO3 mutant maze-run
Learning				
Memory Formation				
Visual Perception				
Sensory Response				
Metabolism				



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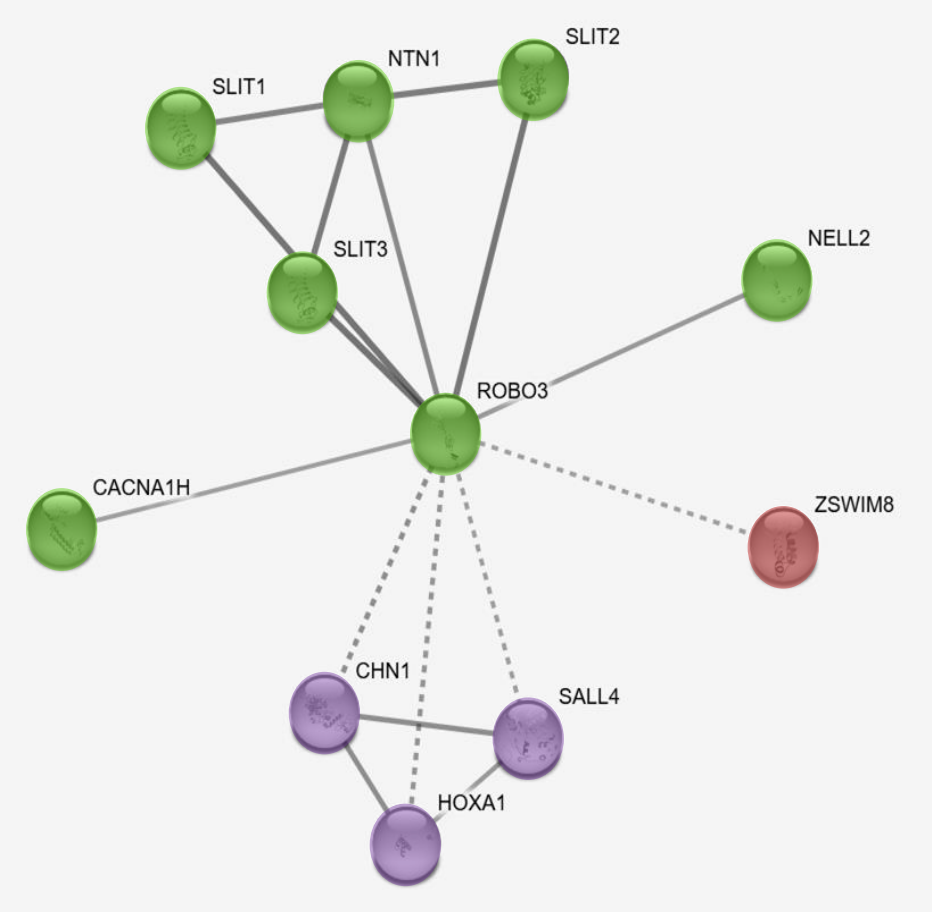
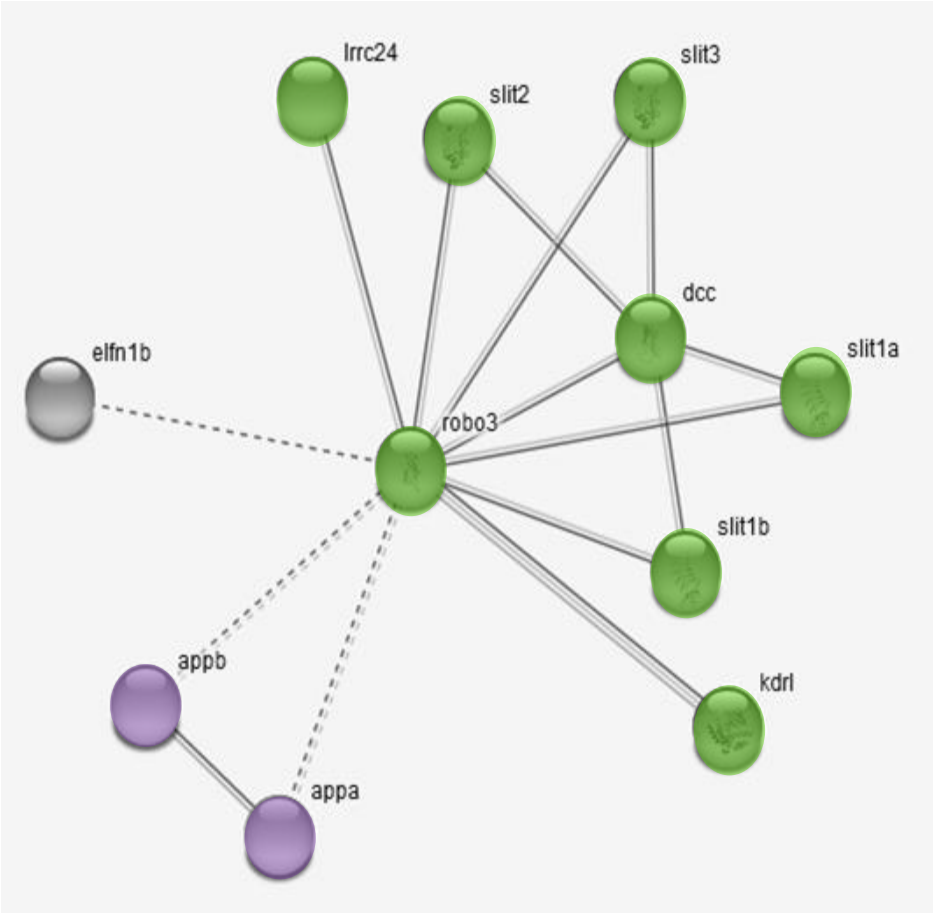
Aim 3: Protein Interactions



Axon guidance

Zinc ion binding

Early nervous system development

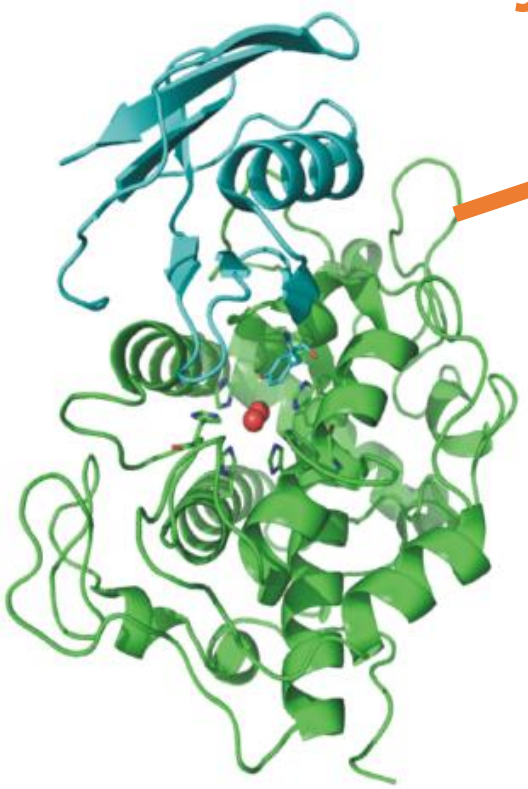


Human

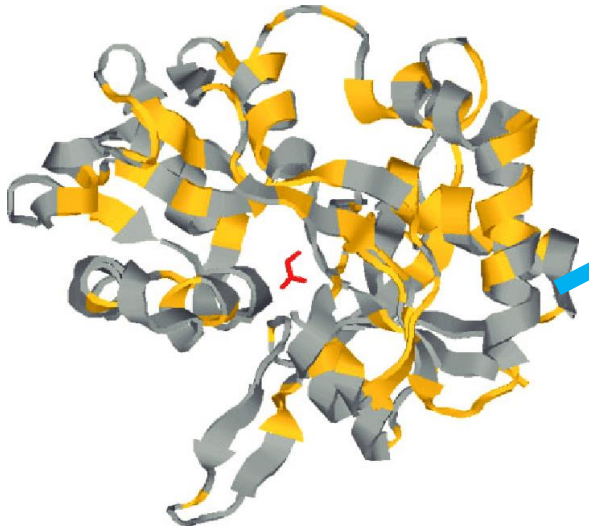
Zebrafish

Aim 3: Protein Interactions

Tyrosinase



ROBO3



GRIN1

Aim 3: Protein Interactions

Tyrosinase

Protein	GO Term Function
SOX10	Embryonic development
SLC45A2	Melanin production
?	?
OCA2	Melanin production

ROBO3

Protein	GO Term Function
SLIT3	Axon guidance
?	?
APPA	Neural development
ELFN1B	Unknown

GRIN1

Protein	GO Term Function
GRIN1	Axon guidance
?	?
LOC559976	Unknown

Conclusions

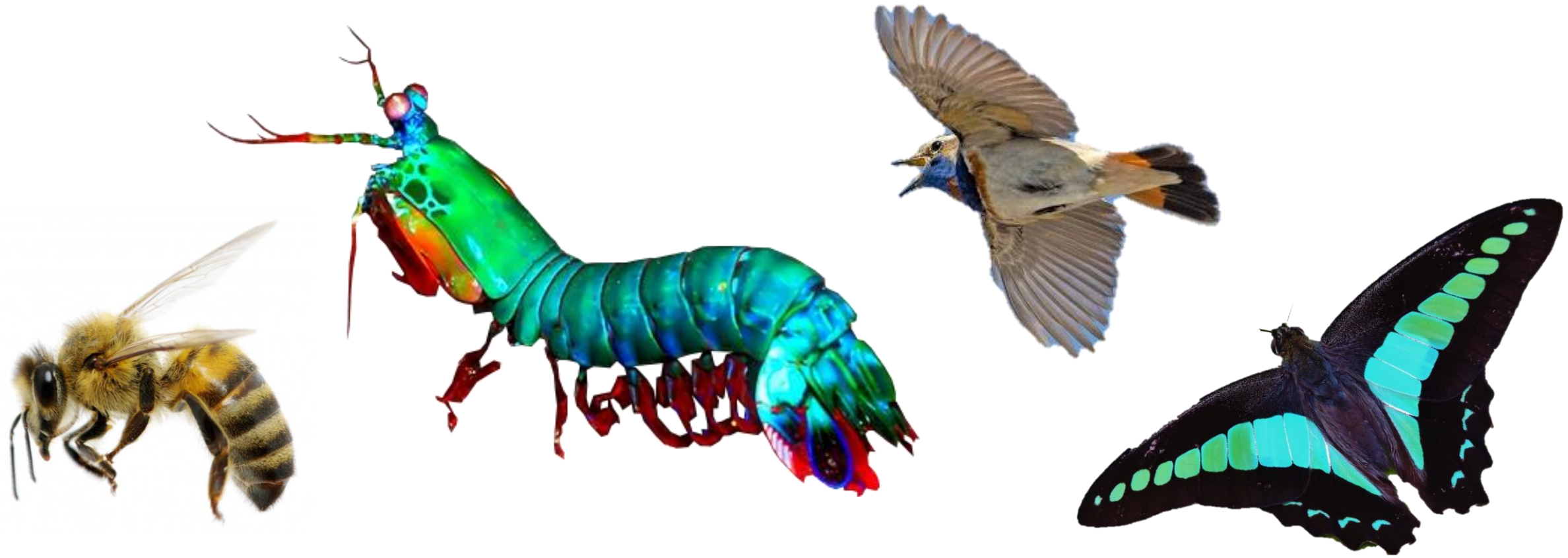
ROBO3, an **axon guidance** gene, is involved in synesthesia

Human synesthetes with **enhanced color perception** have varied **learning** abilities

ROBO3 **protein domain significance**, **differential gene expression**, and **protein interactions** have implications for understanding color perception and learning

Future Directions

How does color perception impact learning and memory development for diverse species?



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