Life Sciences Engineering: Genome To Function

Welcome!

But before we dive into this... a word from the section director

SSV Life Sciences Engineering curriculum

Three pillars (represented in Bloc1):

- **Life Sciences**

  BIO-411: Life Sciences Engineering: Genome To Function

- **Engineering and Bioengineering**

  Spring 2025- : Next-generation biomaterials

- **Computation and Biological Data Science**

  BIO-463: Genomics and bioinformatics

Life Sciences Engineering: Genome To Function

Today’s menu

Introduction to course:

- Overview of **goals and contents** of the course
- Provide some **practical aspects**

Lecture 1:

- Decoding and Understanding Genomes

Overall goals

- Taking you on a journey from **genome to function**
- **Understand** how the genome can be engineered, interrogated and its output analyzed to uncover biological function
- **Transversal themes** in the life sciences engineering: widely applicable concepts and analytical tools

Contents (in brief)

- Module 1: Understand how **genomes can be engineered**
  Brian McCabe

- Module 2: Understand how **genome function can be deciphered**
  Pierre Gönczy

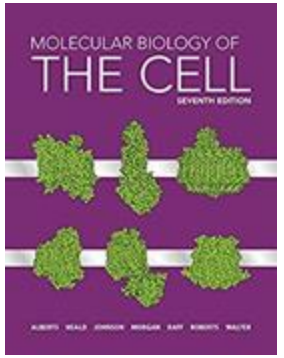
- Module 3: Understand and model **gene expression dynamics**
  Félix Naef

Cautionary notes

- Part of what will be covered –in particular in module 1- **may be known to many of you**
- Note, however, that **not everyone has the same background**, and we want to bring everyone up to speed
- **Supplementary material** is available on Moodle
- **In addition**, TAs will be available at 5pm during the first exercise session of each module to help fill potential knowledge gaps
- Regardless of your background, the contents will rapidly become **more complex**

Typical weekly cycle

- **Thursday, 1:15pm – 3pm, CM1 1**: lecture
- **Monday, 4:15pm - 6pm, SG 0211**: exercises
- **TAs**: **Petra** Balbi, **Florian** Curvaia, **Cecilia** Fruet, **Schuyler** Stoller, (**Maxine** Leonardi)
- Lecture available on **Moodle** typically the Tuesday before (augmented version after lecture), exercises for the following Monday by Friday night
- Additional information if needed:
  Molecular biology of the cell (copies at the library)
- **Further references** in weekly lectures



Topics (week indicates that of lecture)

- **Week 1:** Decoding & Understanding Genomes (BM)
- **Week 2:** Manipulating Nucleotides 1 (BM)
- **Week 3:** Manipulating Nucleotides 2 (BM)
- **Week 4:** Manipulating Proteins (BM)
- **Week 5:** Forward genetic screens (PG)
- **Week 6**: Functional genomic screens (PG) (Lecture: Monday Oct 14th)
- **Week 7**: Synthetic lethal screens + chemical genomics (PG)

Topics (continued)

- **Week 8:** Interfering with proteins + analyzing non-model organisms (PG)
- **Week 9:** Gene expression dynamics: Deterministic models (FN)
- **Week 10:** Gene expression dynamics: Stochasticity (FN)
- **Week 11:** Chronobiology: key facts and concepts (FN)
- **Week 12:** Chronobiology: mechanisms and physiology (FN)
- **Week 13:** Mock exam questions + Q&A
- **Week 14:** Continuous control (70% of final grade)

Exercise sessions

- Exercises are related to topic of previous week, and will put your **problem-solving skills** into practice
- Exercises: **integral part of the course**
- **Weeks 1 and 2** of each module: reading scientific paper, questions stemming from lecture, solving problems, computational exercises, …
- **Weeks 3 and 4** of each module: group project, graded assignments
- **Assignment due dates**: October 11th (Module 1), November 15th (Module 2), December 13th (Module 3)

Course evaluation

- In weeks 3+4 of each module, randomly formed groups of 4 students work together on a **written assignment**, each contributing 10% of the final grade; everyone must contribute!

- **Continuous control** in week 14 (Monday December 16th), 2 hours, mix of multiple choice and open questions, 5 pages (double-sided) of notes allowed; 70% of the grade.

- Note that that the continuous control will cover material seen and discussed during **both lectures and exercises**

- **Examen blanc** on the open questions part + Q&A -December 12th

Generative AI in projects?

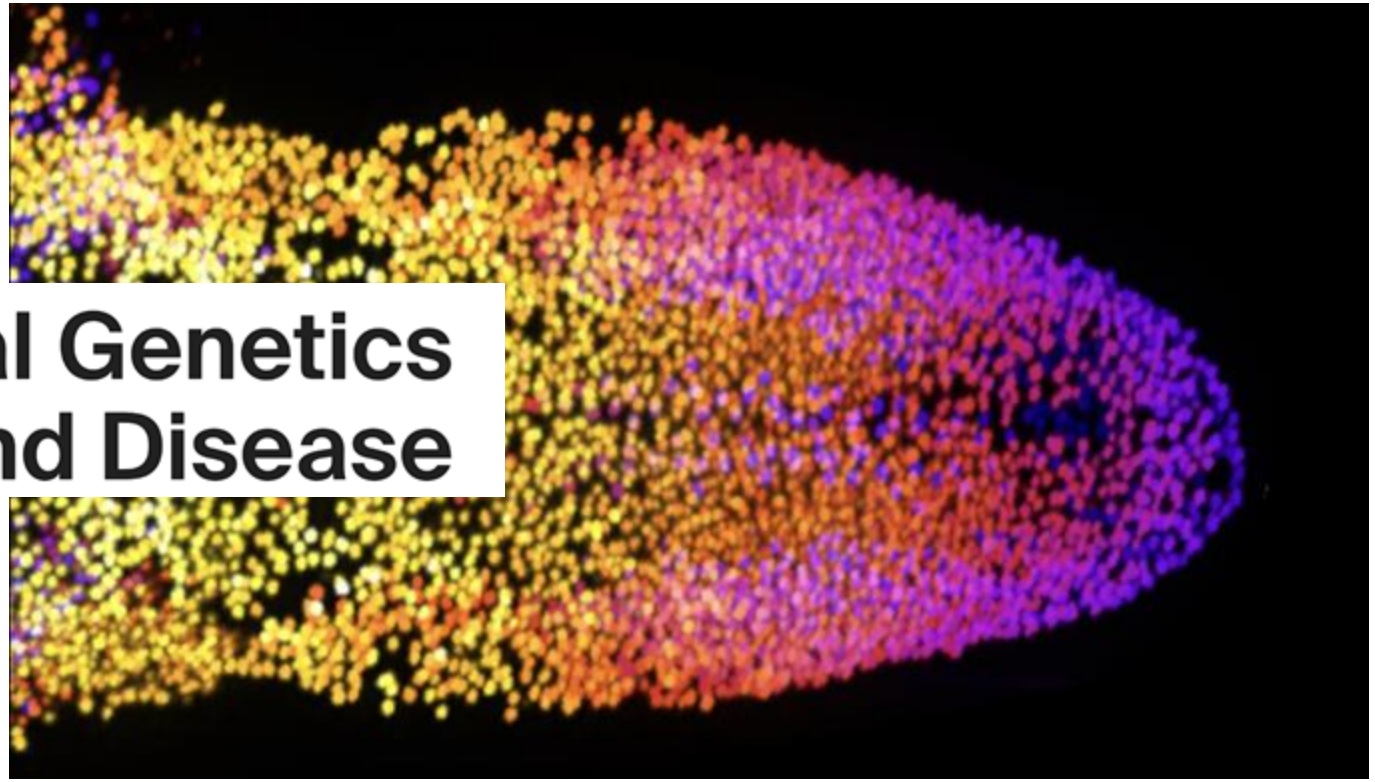
- **Possible, but at your own risk**: leaving the task to generative AI in the projects will not prepare you to solve analogous problems during the continuous control
- It is good practice to **disclose** this in the written assignments if you do so
- Ultimately, you are **the one responsible** for what is written

Who are we?

Who are we?

Brian McCabe

Dublin > Cambridge > Berkeley > New York City > Lausanne

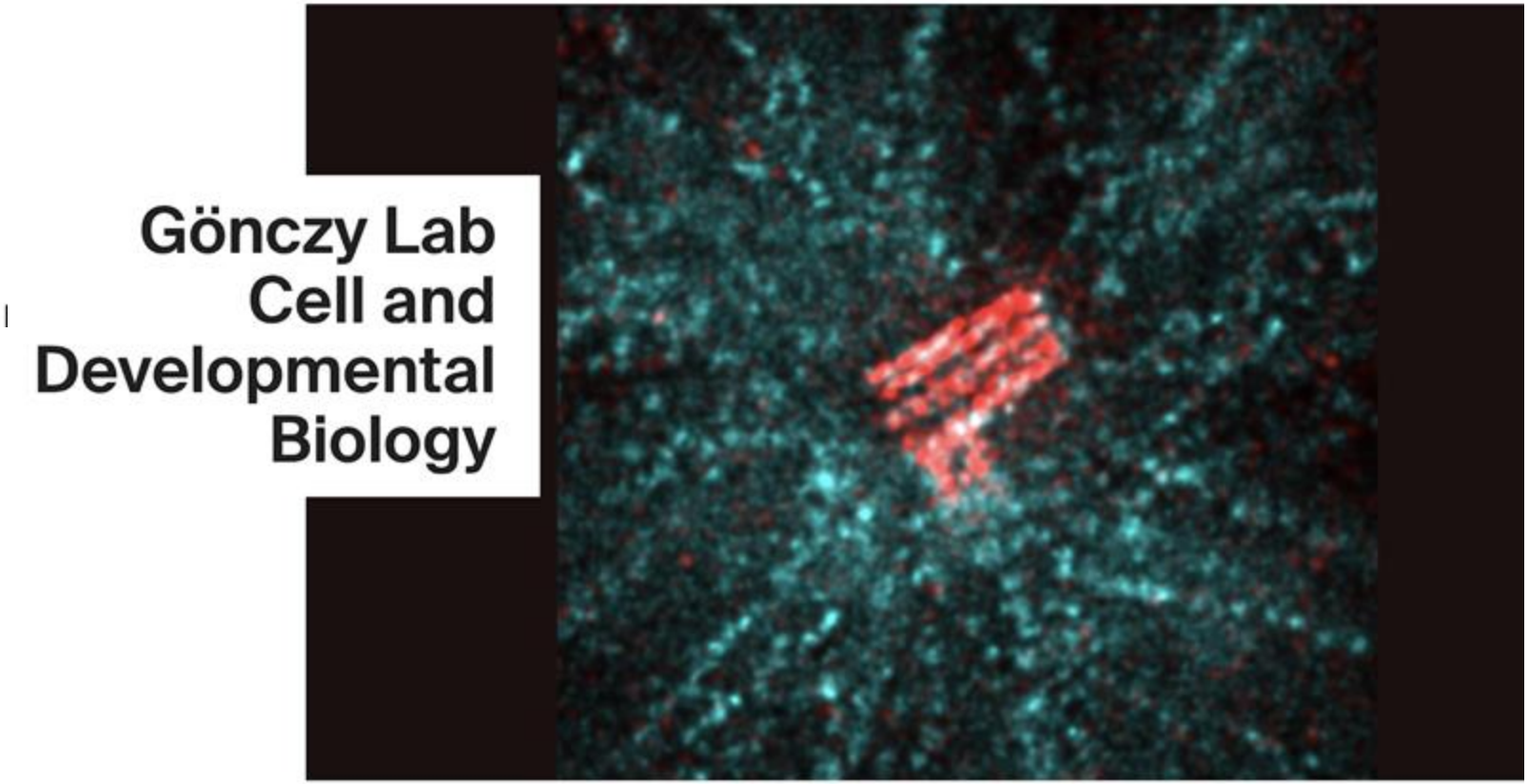


https://mccabelab.org

Who are we?

Pierre Gönczy

Geneva > New York City > Heidelberg > Lausanne



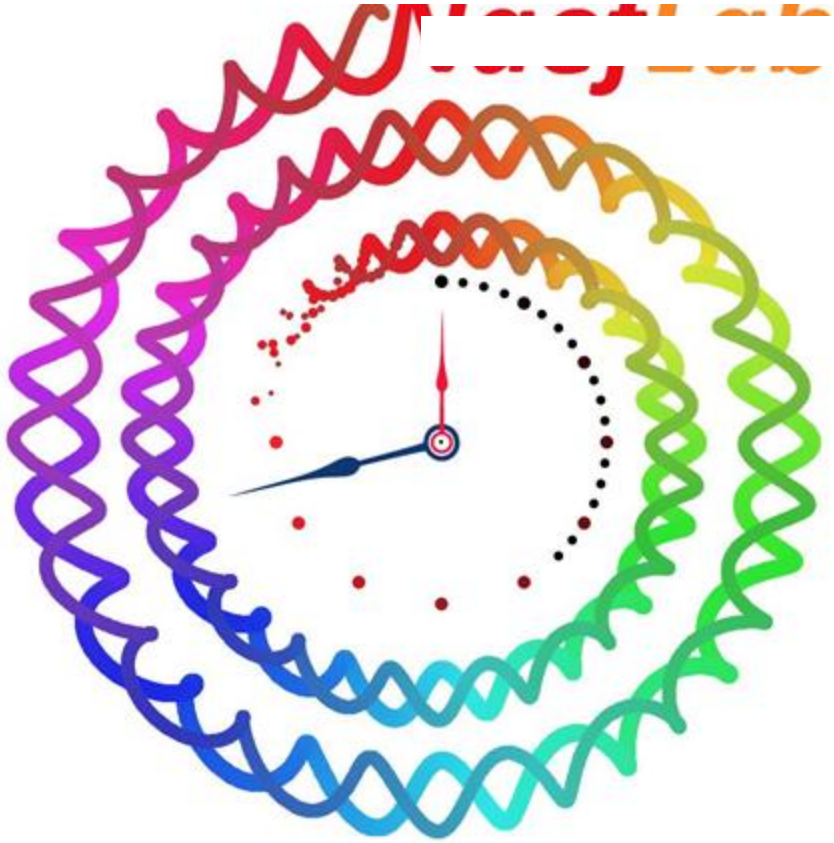
https://www.epfl.ch/labs/gonczy-lab/

Who are we?

Felix Naef

Zürich > Lausanne > New York City > Lausanne

Naef lab – UPNAE Laboratory of Computational and Systems Biology



https://www.epfl.ch/labs/naef-lab/

Obvious reminder: core values

Recurrent special feature: clickers

- **At the onset of each lecture** (starting next week): quiz about previous week's material
- **During the lectures**: other questions

https://participant.turningtechnologies.eu/en/join
https://go.epfl.ch/TurningPointPoll

Session ID: **bio411a**

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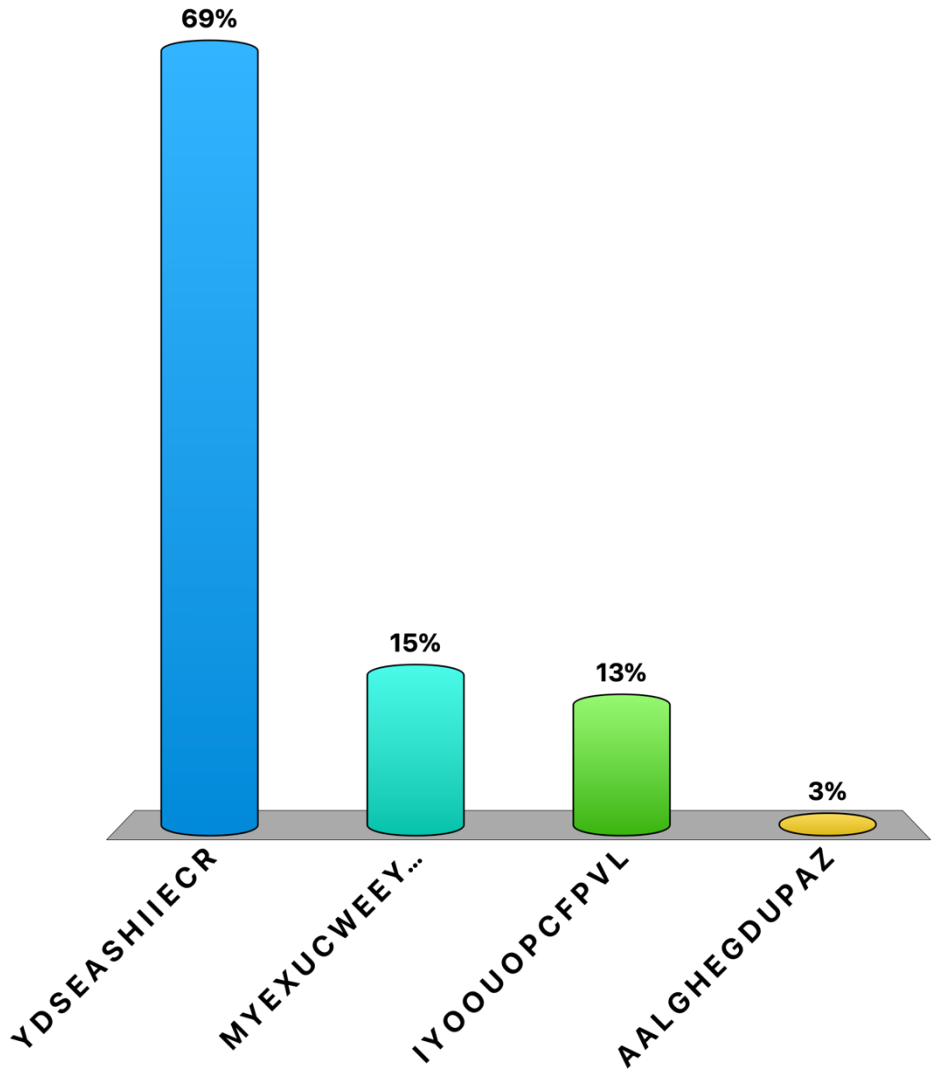
Session ID: bio411

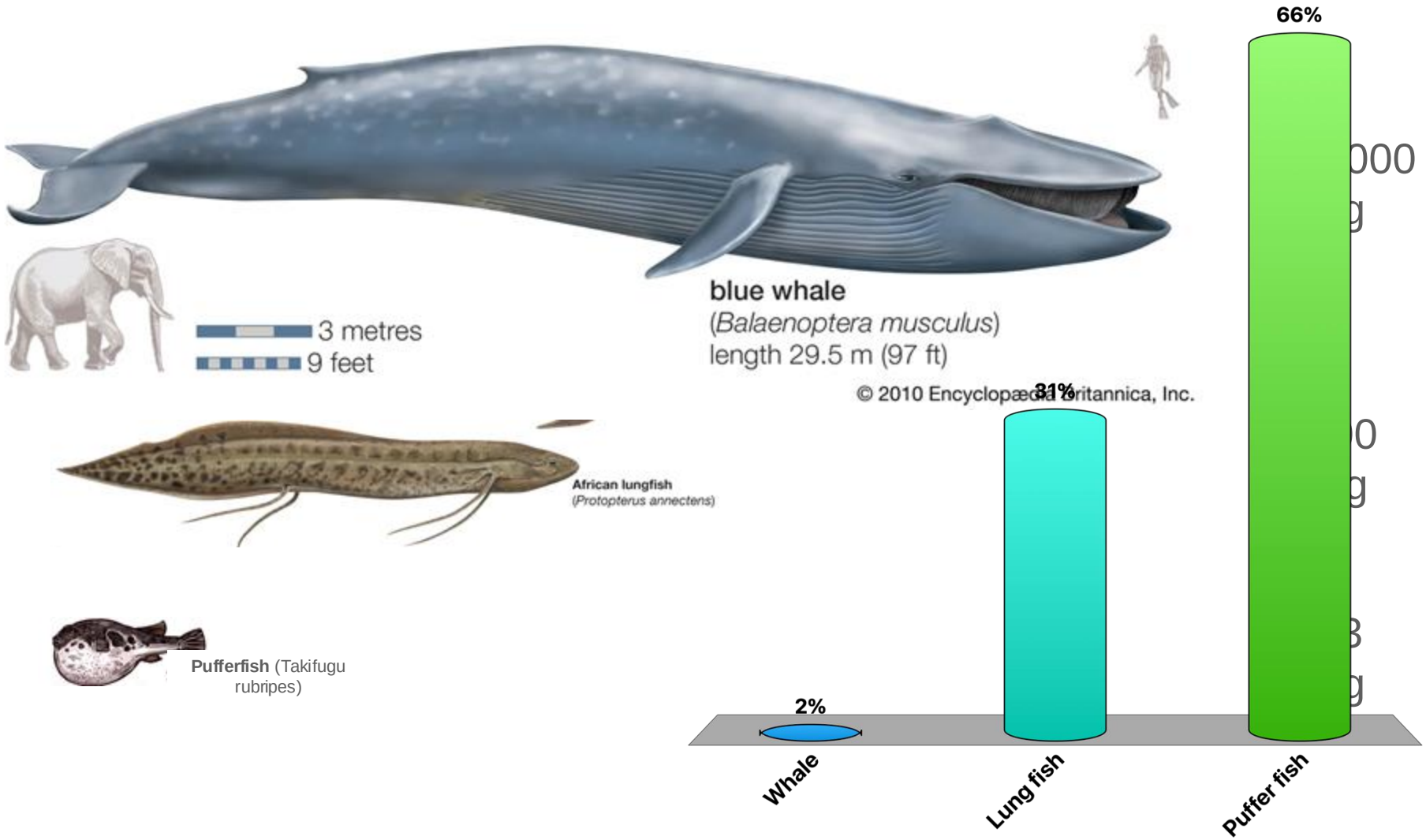
C_R_A_I_N _H_T_M_ &G_N_T_C_

A. Y D S E A S H I I E C R
B. M Y E X U C W E E Y N U
C. I Y O O U O P C F P V L
D. A A L G H E G D U P A Z



Teaser 1: which has the bigger genome?

A. Whale
B. Lung fish
C. Puffer fish



B. Lungfish!

A.

3.09 GBP

B.

130 GBP

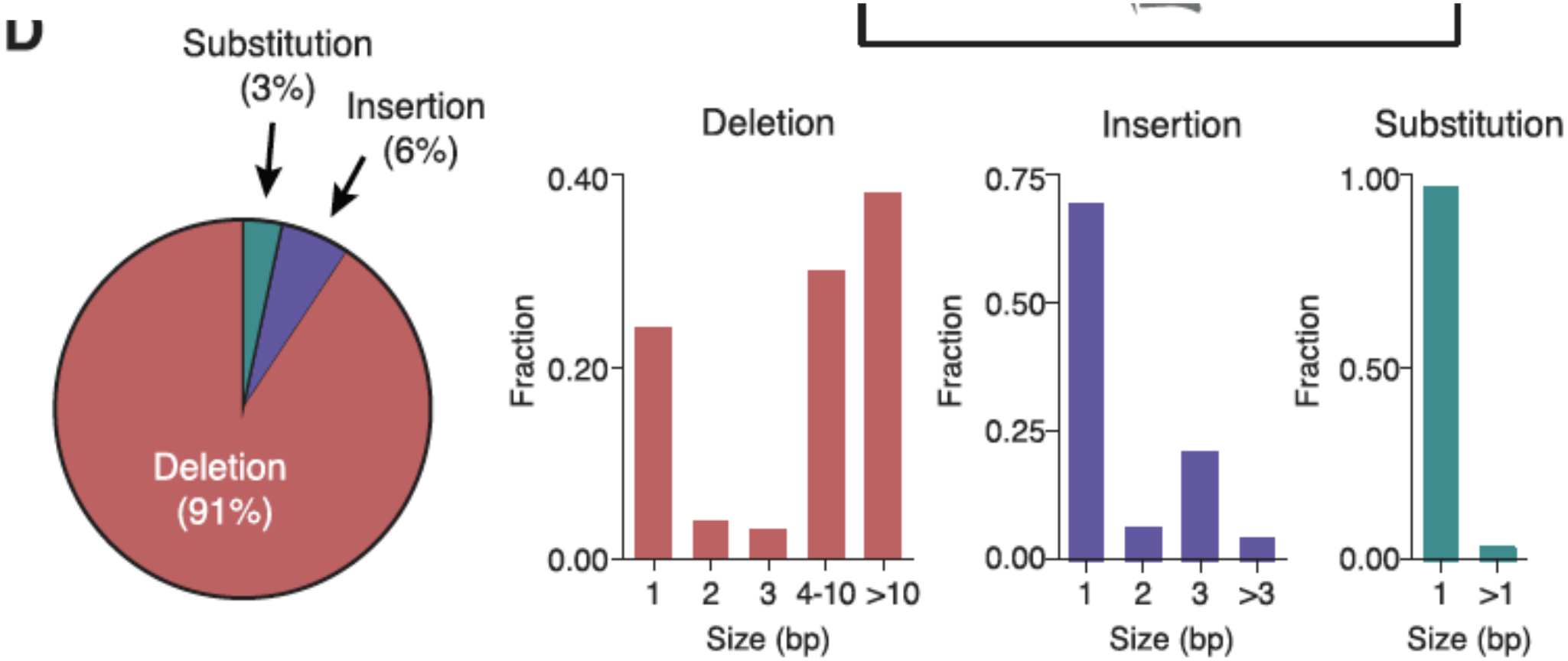
C.

0.4 GBP

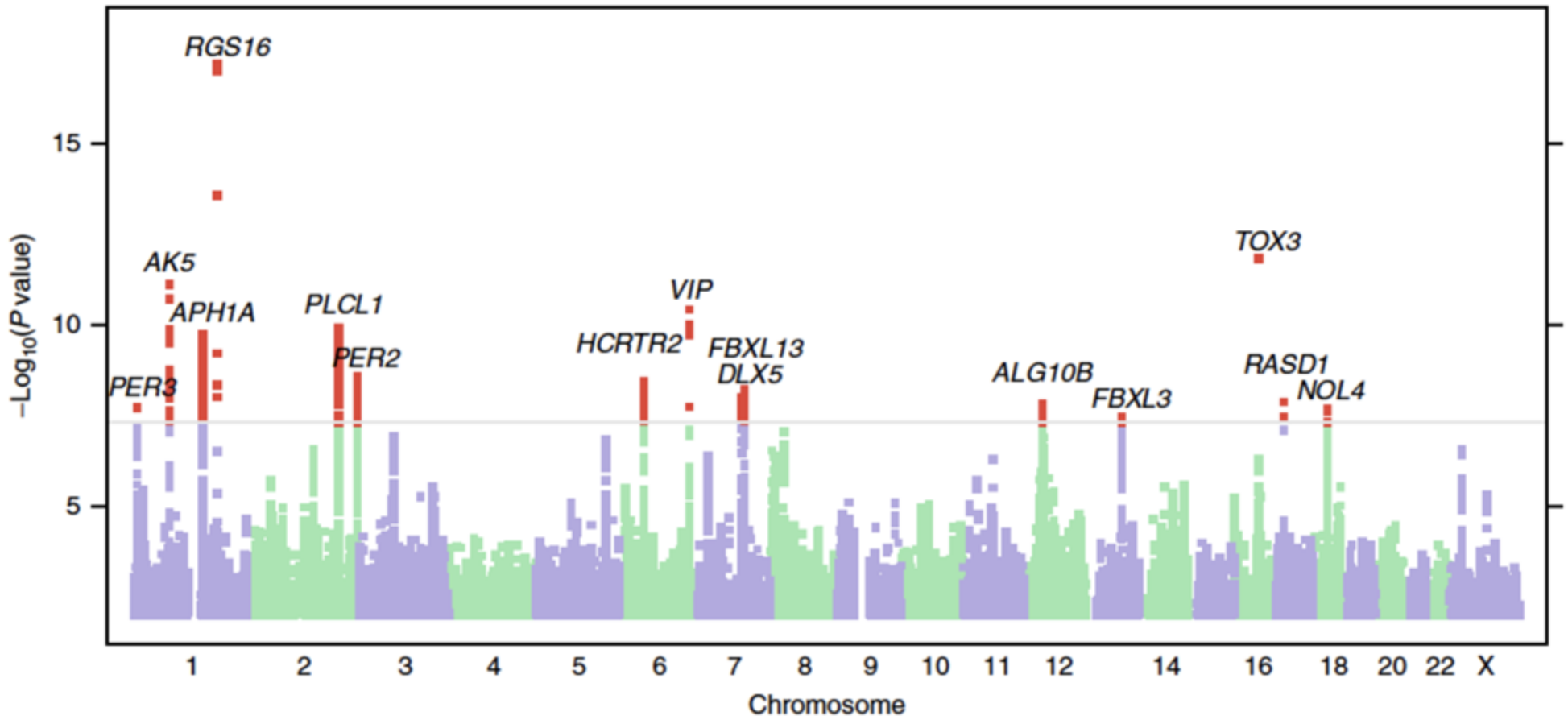
~400 Mb

GENOME TO FUNCTION
LIFE SCIENCES ENGINEERING

Teaser 2: what is represented here?



Teaser 3: what is represented here?



Questions?