

## **Course KB8019 Comparative Genomics, 7.5 hp**

Preliminary schedule for 2020, version 3/12/20, subject to change.

Hosted by Stockholm University, DBB.

Course goals: to learn current techniques for analysing genomes and how comparative genomics can be used to understand the organisation, evolution, and function of genomic sequences.

Course literature:

- Web resources.
- Zvelebil and Baum, [Understanding bioinformatics](#). Not as up to date as the web resources but has more in-depth explanations of many concepts and algorithms.

Course begin/end: May 4 – June 5 2020 (21/5 is a holiday)

- Classes by Prof. Erik Sonnhammer
- The listed literature must be read before each class. Time is reserved for this in the morning of the class day.
- Practicals are done in the DBB computer room, A244 at Arrhenius. Assistants will be present on times listed below. Note that the computer room is only accessible during office hours.
- Reports for practicals should be submitted during the week they are listed, but at the latest the Monday after.
- Slides will be provided after the class.
- Teacher assistants: Miguel Castresana and Deniz Secilmis
- Course information at <http://www.nada.kth.se/~erison/>
- Students need to add themselves to Canvas at <https://canvas.instructure.com/enroll/W7FA9P> in order to take the quizzes.

### **Week 1. The structure of prokaryotic and eukaryotic genomes; Gene prediction**

May 4, 10.15 (DBB computer room): Roll call

Introduction to course and start of practicals

Practical 1: Basic genome analysis. Briefing in computer room May 4, 11.00

Practical 2: Gene prediction. Briefing in computer room May 4, 13.30

TAs present in the computer room on May 4, 6, 8, 10.30-16.30

May 5, 14.00-16.30 (Arrhenius KÖL K438):

Quiz 1 14.05-14.15 on your own device.

14.15-14.30: Information about the fall semester.

Class 1. Genome organisation

Class 2. Gene prediction

Literature:

[http://en.wikipedia.org/wiki/Biological\\_databases](http://en.wikipedia.org/wiki/Biological_databases)

[http://en.wikipedia.org/wiki/List\\_of\\_biological\\_databases](http://en.wikipedia.org/wiki/List_of_biological_databases)

<http://www.yourgenome.org/facts/what-is-a-genome>

[https://en.wikipedia.org/wiki/Domain\\_\(biology\)](https://en.wikipedia.org/wiki/Domain_(biology))

<http://en.wikipedia.org/wiki/Bioinformatics>

<http://en.wikipedia.org/wiki/Genome>

[https://en.wikipedia.org/wiki/Gene\\_prediction](https://en.wikipedia.org/wiki/Gene_prediction)

[http://en.wikipedia.org/wiki/Introduction\\_to\\_genetics](http://en.wikipedia.org/wiki/Introduction_to_genetics)

[http://en.wikipedia.org/wiki/Human\\_genome](http://en.wikipedia.org/wiki/Human_genome)  
[https://en.wikipedia.org/wiki/Repeated\\_sequence\\_\(DNA\)](https://en.wikipedia.org/wiki/Repeated_sequence_(DNA))  
[https://en.wikipedia.org/wiki/Non-coding\\_DNA](https://en.wikipedia.org/wiki/Non-coding_DNA)  
[http://en.wikipedia.org/wiki/Genome\\_evolution](http://en.wikipedia.org/wiki/Genome_evolution)  
<https://en.wikipedia.org/wiki/C-value>

Zvelebil:

Chapter 3 Dealing with Databases  
Chapter 9 Revealing Genome Features  
Chapter 10 Gene Detection and Genome Annotation

## **Week 2. Evolution of genes and genomes**

May 11, 14.00-16.30 (SciLifeLab, Gamma lunch room, level 2):

Quiz 2 14.05-14.15 on your own device.

Class 3. Phylogenetics

Class 4. Phylogenomics

Practical 3: Phylogenetic reconstruction. Briefing in computer room May 12, 10.30

Practical 4: Phylogenomics. Briefing in computer room May 14, 10.30

TAs present in the computer room on May 12 and 14, 10.30-16.30

Literature:

[http://evolution.berkeley.edu/evolibrary/article/phylogenetics\\_01](http://evolution.berkeley.edu/evolibrary/article/phylogenetics_01)

[https://en.wikipedia.org/wiki/Phylogenetic\\_tree](https://en.wikipedia.org/wiki/Phylogenetic_tree)

[https://en.wikipedia.org/wiki/Substitution\\_model](https://en.wikipedia.org/wiki/Substitution_model)

<https://en.wikipedia.org/wiki/Bootstrapping>

<https://en.wikipedia.org/wiki/UPGMA>

[https://en.wikipedia.org/wiki/Neighbor\\_joining](https://en.wikipedia.org/wiki/Neighbor_joining)

<https://en.wikipedia.org/wiki/Phylogenomics>

<http://tiny.cc/3uzk6y> (Lambkin et al., 2009)

<http://genome.cshlp.org/content/8/3/163.long> (Eisen, 1998)

[https://en.wikipedia.org/wiki/Phylogenetic\\_profiling](https://en.wikipedia.org/wiki/Phylogenetic_profiling)

[https://en.wikipedia.org/wiki/Phylogenetic\\_network](https://en.wikipedia.org/wiki/Phylogenetic_network)

[https://en.wikipedia.org/wiki/List\\_of\\_phylogenetics\\_software](https://en.wikipedia.org/wiki/List_of_phylogenetics_software)

[https://en.wikipedia.org/wiki/Phylogenetic\\_tree\\_viewers](https://en.wikipedia.org/wiki/Phylogenetic_tree_viewers)

<https://en.wikipedia.org/wiki/Phylogenetics>

Zvelebil:

Chapter 7: Recovering Evolutionary History

Chapter 8: Building Phylogenetic Trees

## **Week 3. Synteny and orthology analysis**

May 18, 14.00-16.30 (SciLifeLab, Gamma lunch room, level 2):

Quiz 3 14.05-14.15 on your own device.

Class 5. Gene order

Class 6. Orthology

Practical 5: Gene order analysis. Briefing in computer room May 19, 10.30

Practical 6: Orthology. Briefing in computer room May 20, 10.30

Final project assignment: Briefing in computer room May 20, 10.45

TAs present in the computer room on May 19 and 20, 10.30-16.30

Note: May 21 is a red day and the computer room is closed.

Literature:

<https://en.wikipedia.org/wiki/Synteny>  
<https://genomevolution.org/wiki/index.php/Synteny: Getting the Big Picture>  
[https://en.wikipedia.org/wiki/Sequence\\_homology](https://en.wikipedia.org/wiki/Sequence_homology)  
[https://en.wikipedia.org/wiki/Dot\\_plot\\_\(bioinformatics\)](https://en.wikipedia.org/wiki/Dot_plot_(bioinformatics))  
<https://www.ncbi.nlm.nih.gov/pubmed/11934753>  
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5877793/> (Boxes only)  
<http://questfororthologs.org/>  
<http://orthology.benchmarkservice.org/>  
<http://inparanoid.sbc.su.se/>

Zvelebil:

Chapter 7.2 Molecular Evolution and its Consequences

#### **Week 4. Interaction networks**

May 25, 14.00-16.30 (SciLifeLab, Gamma lunch room, level 2):

Quiz 4 14.05-14.15 on your own device.

Class 7. Interaction networks

Practical 7: Interaction networks. Briefing in computer room May 26, 10.30

TAs present in the computer room on May 26 and 28, 10.30-16.30

Literature:

[https://en.wikipedia.org/wiki/Biological\\_network](https://en.wikipedia.org/wiki/Biological_network)  
[https://en.wikipedia.org/wiki/Network\\_science](https://en.wikipedia.org/wiki/Network_science)  
[https://en.wikipedia.org/wiki/Scale-free\\_network](https://en.wikipedia.org/wiki/Scale-free_network)  
<https://en.wikipedia.org/wiki/Interactome>  
[https://en.wikipedia.org/wiki/Systems\\_biology](https://en.wikipedia.org/wiki/Systems_biology)  
[https://en.wikipedia.org/wiki/Pathway\\_analysis](https://en.wikipedia.org/wiki/Pathway_analysis)  
<https://static.springer.com/sgw/documents/139921/application/pdf/4.Barabasi.pdf>  
<http://funcoup.sbc.su.se>, <https://www.ncbi.nlm.nih.gov/pubmed/29165593>  
<http://pathwax.sbc.su.se/>, <https://www.ncbi.nlm.nih.gov/pubmed/27151197>  
<https://string-db.org/>  
<https://david.ncifcrf.gov/>

Zvelebil:

Chapter 17: Systems Biology

#### **Week 5. Project assignments: report writing and preparation of group presentations**

(Briefing in week 3)

TAs present in the computer room on June 2 and 4, 10.30-16.30

June 5, 10.15 (SciLifeLab, Gamma lunch room, level 2): group presentations of final project assignments.