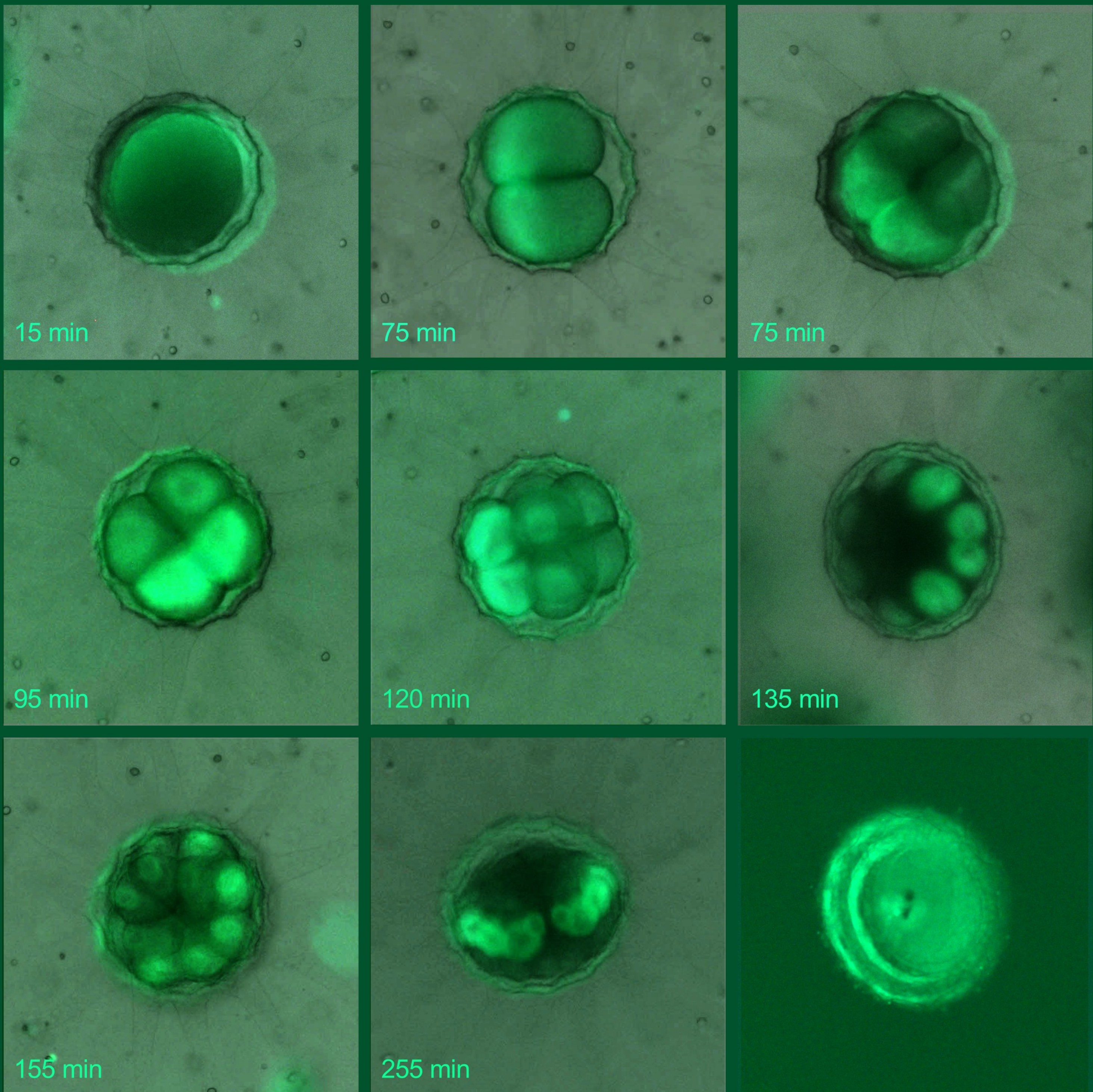
Helgoland Excursion 2021

Developmental Biology & Comparative Molecular Biology of Marine Organisms

Biologische Anstalt Helgoland 21st-28th June 2021



Ernst-Martin Füchtbauer, Molecular Biology & Genetics, Aarhus University
Achim Paululat / Heiko Harten, Zoology & Developmental Biology, Osnabrück University
Peter Heimann, Bielefeld University

Contents

A General Information

Mail address: Wilhelm-Mielck-Haus
Biologische Anstalt Helgoland
D 27491 Helgoland
https://www.awi.de/ueber-uns/standorte/helgoland.html

Director: Karen Wiltshire, Professor, PhD

Responsible for lab courses: Herr Uwe Nettelmann

From Osnabrück

Ferry connections and arrival
All students will travel individually to Cuxhaven, either by train or by car. We will meet at Helgoland ferry terminal of the shipping company “Cassen-Eils” (Am Fährhafen 4, 27472 Cuxhaven). Be in time for a Corona Test at the ferry terminal (mandatory).

Outward, Monday, June 21st 2021
Cuxhaven-Helgoland, Ferry Port (2-2,5 h)
Boarding starts 9:15 Uhr
Departure 10:15
Arrival at Helgoland: 12:30

Return, Monday, June 28th 2021
Boarding starts 16:00 Uhr
Departure 17:00
Arrival at Cuxhaven 19:30

Tickets for the ferry to Helgoland
All tickets will be booked in advance by the course management. You do not have to take care of it.

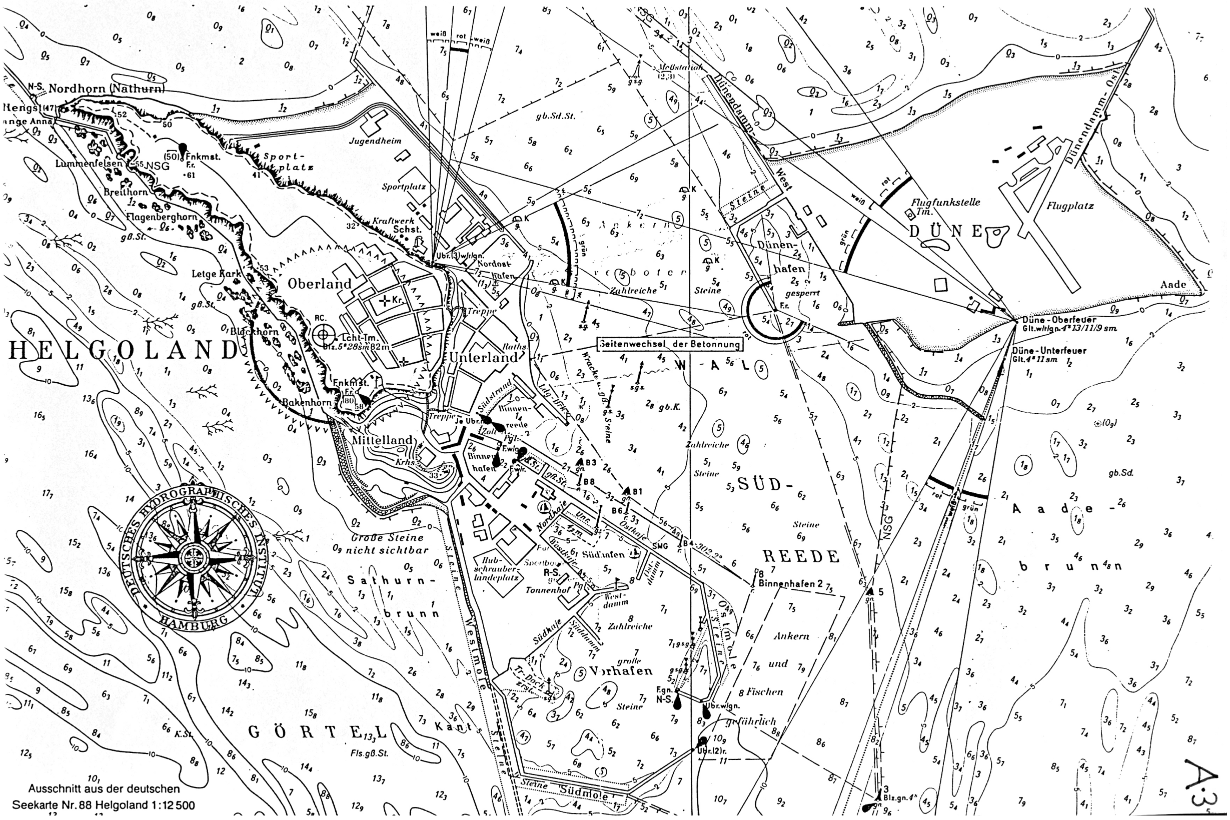
From Aarhus Monday 21st June 2021
By car to Büsum 5:00
Ferry to Helgoland 9:30
Helgoland 12:00

Monday 28th June 2021
Ferry from Helgoland 16:00
Büsum 18:30
Aarhus arrival ca. 22:30

Tide table Helgoland, June 2021

Date	high	low	high	low	high	moon	sunrise	Sunset	moonerise	moonset
Mon 21		03:17 / 0.44 m	09:08 / 2.87 m	15:44 / 0.67 m	21:24 / 3.08 m		04.54	22.05	17.56	02.49
Tue 22		04:26 / 0.43 m	10:11 / 2.89 m	16:54 / 0.60 m	22:28 / 3.06 m		04.54	22.05	19.30	03.08
Wed 23		05:27 / 0.41 m	11:07 / 2.94 m	17:55 / 0.49 m	23:27 / 3.06 m		04.55	22.06	21.02	03.34
Thu 24		06:22 / 0.38 m	11:58 / 3.02 m	18:52 / 0.35 m		full	04.55	22.06	22.22	04.11
Fri 25	00:24 / 3.06 m	07:15 / 0.32 m	12:50 / 3.11 m	19:47 / 0.22 m			04.55	22.06	23.24	05.04
Sat 26	01:21 / 3.06 m	08:07 / 0.28 m	13:44 / 3.19 m	20:41 / 0.14 m			04.56	22.05		06.15
Sun 27	02:17 / 3.04 m	08:57 / 0.29 m	14:37 / 3.22 m	21:34 / 0.17 m			04.56	22.05	00.07	07.38
Mon 28	03:11 / 2.97 m	09:46 / 0.39 m	15:28 / 3.21 m	22:23 / 0.31 m			04.57	22.05	00.36	09.03

http://exnatura.de:9099/locations/1782.html


HELGOLAND
Oberland
Unterland
Mittelland
Nordhorn (Nathurn)
Lummenfelsen
Breithorn
Flagenberghorn
Bakenhorn
Jugendheim
Sportplatz
Kraftwerk
Seitenwechsel der Betonnung
Dünendamm
Dünenhafen
Flugfunkstelle
Flugplatz
DÜNE
Düne-Oberfeuer
Düne-Unterfeuer
SÜD-REEDE
Südhafen
Binnenhafen
Vorhafen
Südmole
Westmole
Sathurn-brunn
GÖRTEL
Aade-brunnen
Ankern und Fischen gefährlich
DEUTSCHES HYDROGRAPHISCHES INSTITUT HAMBURG
Ausschnitt aus der deutschen
Seekarte Nr. 88 Helgoland 1:12 500

Participants, e-mails, phone numbers

Participants from Aarhus		
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BI	Peter Heimann	peter.heimann@uni-bielefeld.de	+49 157 73824024

Seminar topics June 2021

No	Topic	Names	Chair
	Attraction and Fertilization		
1	Self-sterility in *C. intestinalis*	Kasper Ravn	5
2	Cherchez la femme – impact of ocean acidification on the egg jelly coat and attractants for sperm	Konrad Wellmann	6
	Development in Ciona		
3	Muscle development in ascidian	Sofie	7
4	Heart mode *C. intestinalis*	Ulla Obermeyer	8
	Development and ecology of sea urchin		
5	The sea urchin Diadema africanum uses low resolution vision to find shelter and deter enemies	Anna Mazur	1
6	Bioerosion by pit-forming, temperate-reef sea urchins: History, rates and broader implications	Anna Milchin	2
7	CRISPR in sea urchins	Jessica Ludwig	3
8	Microbiome in sea urchins	Nina Schonhoven	4

The column 'Chair' indicates for which topic you should prepare questions, and lead the discussion.

Literature:

Attraction and Fertilization:

1. Self-sterility in *Ciona intestinalis*

Marino R., De Santis R., Giuliano P., Pinto M.R. (1999) Follicle cell proteasome activity and acid extract from the egg vitelline coat prompt the onset of self-sterility in Ciona intestinalis oocytes. Proc NatlAcadSci U S A 96:9633-6.

Yamada L., Saito T., Taniguchi H., Sawada H., Harada Y. (2009) Comprehensive egg coat proteome of the ascidian *Ciona intestinalis* reveals gamete recognition molecules involved in self-sterility. J BiolChem 284:9402-10.

Sawada H, Yamamoto K, Yamaguchi A, Yamada L, Higuchi A, Nukaya H, Fukuoka M, Sakuma T, Yamamoto T,Sasakura Y, Shirae-Kurabayashi M (2020) Three multi-allelic gene pairs are responsible for self-sterility in the ascidian Ciona intestinalis. Scientific reports 10:2514 https://www.nature.com/articles/s41598-020-59147-4

2. Sperm attraction

Foo SA, Deaker D, Byrne M. (2018) Cherchez la femme - impact of ocean acidification on the egg jelly coat and attractants for sperm. J Exp Biol. 2018 Jul 2;221(Pt 13):jeb177188. doi: 10.1242/jeb.177188.

Development in Ciona

3. Muscle development in ascidian embryos

Nishida H, Sawada K. (2001) Macho-1 encodes a localized mRNA in ascidian eggs that specifies muscle fate during embryogenesis. Nature 409:724-9.

Pourquie O. (2001) Developmental biology.A macho way to make muscles.Nature 409:679-680.

Meedel T.H., Farmer S.C., Lee J.J. (1997) The single MyoD family gene of Ciona intestinalis encodes two differentially expressed proteins: implications for the evolution of chordate muscle gene regulation. Development 124:1711-21

4. Heart model *Ciona* I

Anderson, H. E., & Christiaen, L. (2016). *Ciona* as a Simple Chordate Model for Heart Development and Regeneration.Journal of Cardiovascular Development and Disease, 3(3).http://doi.org/10.3390/jcdd3030025

Waldrop, L. D., & Miller, L. A. (2015). The role of the pericardium in the valveless, tubular heart of the tunicate *Ciona savignyi*. Journal of Experimental Biology, 218(Pt 17), 2753–2763. http://doi.org/10.1242/jeb.116863

Development in sea urchins

5. The sea urchin Diadema africanum uses low resolution vision to find shelter and deter enemies

Kirwan JD, Bok MJ, Smolka J, Foster JJ, Hernández JC, Nilsson DE. (2018) The sea urchin Diadema africanum uses low resolution vision to find shelter and deter enemies. J Exp Biol. 221(Pt 14). pii: jeb176271. doi: 10.1242/jeb.176271

6. Bioerosion by pit-forming, temperate-reef sea urchins: History, rates and broader implications

Russell MP, Gibbs VK, Duwan E. (2018) Bioerosion by pit-forming, temperate-reef sea urchins: History, rates and broader implications. PLoS One. 13(2):e0191278. doi: 10.1371/journal.pone.0191278. eCollection 2018.

7. CRISPR in sea urchin

Che-YiLin, Yi-Hsien Su (2016) Genome editing in sea urchin embryos by using a CRISPR/Cas9 system. Developmental Biology 409 (2): 420-428. *https://doi.org/10.1016/j.ydbio.2015.11.018*

8. Microbiom in sea urchins

Tyler J. Carrier, Brittany A. Leigh,Dione J. Deaker, Hannah R. Devens, Gregory A. Wray, Seth R. Bordenstein, Maria Byrne, and Adam M. Reitzel (2021) Microbiome reduction and endosymbiont gain from a switch in sea urchin life history. PNAS April 20, 2021 118 (16) e2022023118; *https://doi.org/10.1073/pnas.2022023118*

Introduction: What the course is about

The course **"Helgoland: Developmental Biology and Comparative Molecular Biology of Marine Organisms"** is intended to be a lab course rather than an excursion aimed at ecological observations. However, if we are still allowed, we will spend some time on the rock shore, which is unique in Germany and Denmark except for Bornholm. During low tide, we can see the organisms in their natural habitat and collect specimens for cell biological, biochemical, and molecular analysis in the lab. We should take the time to enjoy nature on Helgoland, especially the spectacular sea bird colony that is unique to Central Europe.

We will be guests of the Biologische Anstalt Helgoland, which belongs to a federal institute, the Alfred Wegener Institute at Bremerhaven, on the mainland. The BAH is rather unique in the world in that we do not have to pay a fee for the use of the laboratory facilities. In return, we are asked to exert great care with the instrumentation and to leave the course room in a perfectly clean state, when we depart.

In terms of taxonomy, marine organisms, and specifically marine animals, represent a much wider scope than freshwater species. Important taxa such as sponges, Hydrozoa, Polychetes, Cephalopods, Ascidians, and Echinoderms are preferentially or exclusively found in the marine environment. Basic research on marine organisms has made important contributions to general biology: Think of fertilization and the significance of the nucleus and chromosomes for development (Theodor Boveri), the potency of blastomeres in development (sea urchin, Ascidians), the mechanism of nerve conduction (giant axon of the squid), or, in more recent years, factors involved in of cell sorting (sponges) and the neurobiochemistry of simple forms of learning (conditioning of the gill withdrawal reflex, *Aplysia*) – you may like to recall your basic textbook knowledge on these findings and connect them to famous names of researchers and Nobel prize winners!

Nearly all marine metazoa have a severe drawback for modern molecular analysis of development: Genetic analysis based on breeding in the laboratory is impossible, very difficult or at least extremely slow. This is a big difference to *Caenorhabditis*, *Drosophila* and mouse! However, in the time of genome sequencing, knock down methods, and particularly CRISPR/Cas, these drawbacks have been partially overcome and echinoderms and tunicates now entered the 'molecular age'.

In our course we will try to repeat, with simple methods, some findings of classical and modern developmental biology for which marine organisms have turned out to be particularly useful. Furthermore, we will perform experiments that are applicable to any animal species and relate to tissue differentiation and evolution of genes.

One difficulty of the course is that there is no clear fixed course plan. You will see, that such a plan is almost impossible to make because many factors are unpredictable beforehand. The course thus builds much more on your own initiative than you are used to from other courses. It is your own responsibility to make sure that you can get introduced to all organisms, but you will not be able to do all experiments. This might look like a limitation, but it also gives you the freedom to choose and to focus on those aspects you consider most interesting. The more active you are the more you will enjoy the course! We will try hard to help you with all the practical and theoretical questions you might have.

Ernst-Martin, Achim, Heiko and Peter June 2019

Acknowledgement: We thank Harald Jokusch, who initiated and organized the first course on "Molecular and Developmental Biology of Marine Organisms" on Helgoland 1984.