



**NTNU – Trondheim**  
Norwegian University of  
Science and Technology

Department of Biology

## **Exam in Bi3013**

### EXPERIMENTAL CELL AND MOLECULAR BIOLOGY

**Contact person during examination:**

**Assistant professor Per Winge**

**Phone: 99369359**

**Examination date:** 7<sup>th</sup> December, 2015

**Examination time (from-to):** 09.00 – 13.00 (4 hours)

**Permitted examination support material:** None

**Other information: Language:** English

**Number of pages:** 3 (including front page)

**Number of pages enclosed:** 0

**Checked by:**

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Date

Signature

NOTICE THAT QUESTIONS 1, 2, 3, AND 4 ARE WEIGHTED EQUALLY, BUT SINGLE QUESTIONS MIGHT BE WEIGHTED DIFFERENTLY (INDICATED IN %). IF NO WEIGHTING IS GIVEN THE SUB-QUESTIONS ARE WEIGHED EQUALLY. PLEASE START ANSWERING EACH QUESTION (1, 2, 3, and 4) ON A NEW SHEET OF PAPER.

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### **Question 1**

To find out how an algae responds to lack of a nitrogen source (nitrate and ammonia) in the growth medium you decide to examine which genes are affected by the treatment (whether gene expression is up or down regulated). The genome of this alga is not known and no one has studied it previously.

- a. Explain how you will set up such an experiment and what factors that you may have to consider. How would you grow and treat the algae, and how would you harvest the samples? (20 %)
- b. Describe how you will harvest RNA from the samples and what quality analyzes of the RNA you will perform (40 %).
- c. Explain how you will identify the genes affected by the treatment (whether gene expression is up or down regulated). Explain your choice of method and describe the various steps in the process. (40 %)

### **Question 2.**

The transcription analysis of the algae exposed to nitrogen limitation identified a highly up regulated gene that encode a small GTPase. You therefore decide to produce an alga where the function of this GTPase is changed.

- a. Describe how you will proceed to produce an alga where the gene encoding the GTPase is inactivated. The answer should contain a description of transformation method, description of plasmid vector and how you identify transformed algae. (40 %)
- b. Explain how you will verify the inactivation of the GTPase gene. You can use methods described and used in the laboratory course. (30 %)
- c. Small GTPases act like on off switches for various cellular responses. By changing one specific amino acid in the GTPase (glycine → valine) it can be converted to a constitutive active form. Explain how you can change the alga genome sequence such that the GTPase is transformed to an activated form. (30 %)

**Question 3.**

- a. Describe the principles of confocal microscopy and give a short description of how a confocal microscope is constructed.
- b. Describe two methods which are used to identify protein-protein interactions.
- c. Explain the principle behind 2D gel electrophoresis and describe how you will identify proteins from a 2D gel.

**Question 4.**

Explain or describe the following terminologies/techniques, use figures wherever necessary (not more than 200 words for each).

- a. ChipSeq.
- b. Gene drive.
- c. Liquid chromatography and mass spectrometry (LC/MS).
- d. Stimulated emission depletion (STED) microscopy.