Student Code:

24th International Biology Olympiad

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Bern, Switzerland

BERN 2013 International Biology Olympiad

Practical Exam

Molecular Cell Biology

Answer Key

Q1

	true	false
If the suspension of a strain incubated with X-gluc turns blue, the β-glucuronidase gene was successfully introduced.	V	
Inferring the successful introduction of the gene of interest based on the presence of the reporter gene (β-glucuronidase) may result in false positives or negatives if only one gene of the construct was successfully inserted.	V	
The location in the genome where the construct is introduced affects the level of gene expression of the introduced genes.	V	
A similar approach with magnetic beads and specific antibodies can be used to separate cells, with successful deletion of a gene coding for an intracellular protein, from cells where the deletion did not work.		V

0.5 points per correct answer
-> 2 points in total

Q2

	Strain T1	Strain T2	Strain T3
Blue			
Clear			

1 point per strain if the tube is present and the color reported in the table is the one the tube actually has
9 points if the color pattern on the picture is correct, 4.5 points if only 2 tubes are correct, 0 points if 0 or 1 are correct
-> 12 points in total

Q3

Volume of 1 counting square (mm^3)	**0.1**
Volume of 1 counting square (ml)	**10^{-4} or 0.0001**

0.5 points per correct answer
-> 1 point in total

Q4

	Strain T1	Strain T2	Strain T3
Square 1			
Square 2			
Square 3			
Mean counts per square			

Experimenters will repeat these measurements multiple times with the same material as the students. Their values will be computed as an interval with mean m and width d between the 2 most extreme values.

9 points per strain if the values (means) are within the interval [m-0.5d; m+0.5d] (same interval as obtained by the experimenters), 6 points if the values are within the interval [m-1d; m+1d], 3 points if the values are within the interval [m-1.5d; m+1.5d], 0 points if the values are further away -> subtotal 27
9 points if the ratios between the strains is correct. This is to accord points to students who forgot a dilution step but counted correctly -> subtotal 9
0.5 per strain if the mean counts per square is correct and with 3 digits after the decimal point (according to the student's raw values from Q4). 0.1 points (maximum 0.2 points for Q4) will be deduced for cells with the wrong number of digits after the decimal point-> subtotal 1.5
-> 37.5 points in total

Q5

	Strain T1	Strain T2	Strain T3
Square 1			
Square 2			
Square 3			
Mean counts per square			
Standard deviation of counts per square			

Compared to Q4, no pull-down is done in Q5, therefore Q5 gives only 25.5 points.

6 points per strain if the values (means) are within the interval [m-0.5d; m+0.5d] (same interval as obtained by the experimenters), 4 points if the values are within the interval [m-1d; m+1d], 2 points if the values are within the interval [m-1.5d; m+1.5d], 0 points if the values are further away -> subtotal 18
6 points if the ratios between the strains is correct. This is to accord points to students who forgot a
0.5 per strain if the mean counts per square is correct and with 3 digits after the decimal point (according to the student's raw values from Q5). 0.1 points (maximum 0.2 points for Q5) will be deduced for cells with the wrong number of digits after the decimal point-> subtotal 0.75
-> 25.5 points in total

Q6

SE_{mean}	

0.6 points if the value is correct (according to the student's values from Q5) and with 3 digits after the decimal point (if not, 0.1 points deduction)
-> 0.6 points in total

Q7

Number of significant digits	

1.5 points if the correct number of significant digits was chosen (according to the student's values from Q5 and Q6)
-> 1.5 points in total

Q8

	Strain T1	Strain T2	Strain T3
Mean counts per square of trypanosomes not binding to magnetic beads (from Part 2.3)			
Mean counts per square of total trypanosomes (from Part 2.4)			

0.1 points per value correctly reported with the number of significant digits indicated in Q7
-> 0.6 points in total

Q9

	Strain T1	Strain T2	Strain T3
Trypanosomes not binding to magnetic beads /ml in dilution used for counting (from Part 2.3)			
Total Trypanosomes / ml in dilution used for counting (from Part 2.4)			

1st line (from part 2.3): (dilution factor =19/20*1/10*9/10=0.0855)
1.5 points for the correct dilution factor (if correct in at least 2 strains), 0.5 points deduction for each forgotten dilution step
0.2 points for each correct value
2nd line (from part 2.4): (dilution factor = 1/10*9/10 = 0.09)$
1 point for the correct dilution factor (if correct in at least 2 strains), 0.5 points deduction if 1 dilution step was forgotten
0.2 for each correct value
-> 3.7 points in total

Q10

	Strain T1	Strain T2	Strain T3
Trypanosomes not binding to magnetic beads /ml in original suspension (from Part 2.3)			
Total Trypanosomes / ml in original suspension (from Part 2.4)			

0.5 points if the factor calculated in Q3 was used
0.1 points for each correct value
-> 1.1 point in total

Q11

	Strain T1	Strain T2	Strain T3
Estimated percentage of trypanosomes **not** binding to beads (%)			

0.5 points per strain if the result is correct and expressed in full percentages. 0.1 points (maximum 0.2 points for Q11) will be deduced for cells were the value was not expressed with the correct number of digits.
-> 1.5 points in total

Q12

	Strain T1	Strain T2	Strain T3
(Almost) only unbound trypanosomes in the sample			
<50% of the trypanosomes present in the sample are bound			
>50% of the trypanosomes present in the sample are bound			

9 points if all three strains are correct (only unbound or according to the experimentaters values), 4.5 points if only 2 strains are correct, 0 points if 1 or 0 strains are correct. Since it would be easy for students to guess some of these answers without actually looking under the microscope only based on the counting, students need to have all three correct to get all the points.
-> 9 points in total

Q13

	Strain T1	Strain T2	Strain T3
A reduction, at least in part due to binding to beads			
No or only a purely stochastic change			

1 point for each strain if correct according to results from Q11 and Q12: point given if ...
... Q13 = a reduction at least in part due to binding && Q11 = reduction observed && Q12 = >50% bound trypanosomes
... Q13 = no or purely stochastic change && Q11 = no reduction observed && Q12 = only unbound trypanosomes in the sample
0 points for other results
-> 3 points in total

Q14

	Strain T1	Strain T2	Strain T3
Highest deletion efficiency			

1 point if correct answer according to results from Q11, Q12 and Q13.
-> 1 point in total

End of the Practical Exam