Component 1 Assessment Brief
Research Skills: MIC11107

1. Module Number	MIC11107
2. Module Title	Research Skills
3. Module Leader	Dr Catharina Alam
4. Responsible Lecturers Student's first point of contact	Dr Catharina Alam & Dr Katarzyna Siemienowicz
5. Assessment	Report: Experimental design and data analysis
6. Weighting	40% of overall module grade
7. Size and/or time limits for assessment	1200 words +/- 10%
8. Deadline of submission	**Monday 4th March** 2024 by **Midday** (week 8 of module)
9. Arrangements for submission	Coursework should be submitted electronically via the FINAL Turnitin submission box on Moodle before the deadline. You must submit the work as a Microsoft Office Word file. You are advised to keep your own copy of the assessment.
10. Assessment Regulations All assessments are subject to the University Regulations	Coursework submitted after the agreed deadline will be marked at a maximum of **P1**. Coursework submitted over five working days after the agreed deadline will be given **F6**. If you know that you will not meet the deadline due to **exceptional circumstances,** you should fill in a RE1 form (extension request form) and contact the module leader in good time **prior** to the submission date. Extensions without a valid RE1 form **will not be considered.**
11. Requirements for the assessment	Full details are provided on the next pages
12. Special instructions	The assessment is done **individually** and is based on research skills taught in the lectures, tutorials and workshops. You are not allowed to use Artificial Intelligence tools for the assessment. *All scientific references should be in the APA7th format.*
13. Return of work and feedback	You will receive written feedback on your submission within 3 weeks of the submission deadline. If you wish to discuss this, please make an appointment with Dr Alam after the module marks have been released.
14. Assessment criteria	Marking scheme is provided on following pages.

Component 1 Assessment Brief Details and Instructions

In this assessment, you are given research data from two different pilot studies. Your task is to critically review, and interpret all the experiments and the data, and then improve the experimental design and analysis to provide more robust, appropriate experiments. For each experiment, you need to:

A) **Critically review and interpret the data.** Explain and justify all your answers!
   - Interpret the data and the statistical analysis (where applicable) presented in the figures.
   - Describe what the results indicate and what information can be extrapolated from the data and/or what conclusions can be drawn from the experiment?
   - Briefly discuss what the data indicates in terms of the effectiveness of the respective test compounds, or their therapeutic potential?

B) **Critically review the experimental setup and data analysis** and **provide a justified plan for how you would improve the experiments** (using the same experimental method) to make them more robust and to provide more conclusive and informative data for the development of these drugs.
   You must identify and explain any weaknesses/shortcomings in the current experimental design and clearly explain and justify how any changes you make to the experiments will improve the experimental setup and analysis, and how and why they will result in better experiments.

   Maximum marks for the assessment: 50 marks for study 1 and 50 marks for study 2. For each study, you can gain max 15 marks for part A and max 35 marks for B.

Pilot study 1: Development of a novel drug: Exobese™ for the treatment of obesity

In this study, the effectiveness of Exobese™ on weight loss and the effect of the drug on appetite was examined using an experimental mouse model. A pilot experiment was conducted to test the efficiency of a novel therapeutic for weight loss called Exobese™, using a laboratory mouse strain called C57/Bl6. The mice were weighed at the start of the experiment (before any drug administration) and after 4 weeks of drug treatment. The experiment was conducted on healthy mice.

The experimental weight measurement data for all the experimental groups is presented below (Table 1). The control group and did not receive any treatment, and the treatment group received daily drug treatments (day 1-28, drug dissolved in saline, delivered by oral gavage). The results and statistical analysis are presented in Figure 1. All animals were given the same normal mouse pellet diet (0.5kg pellets added weekly to each animal cage) and allowed to eat *ad libitum*. Each week the amount of food consumed was calculated (amount consumed = weight of food administered – weight of food remaining at the end of the week), to examine whether the treatment affected appetite (Table 2).

Table 1. Raw data for weight-loss experiment*. Control group and treatment group comprised male and female mice aged between 4-10 weeks at the start of the experiment. All animals were weighed before the start of the experiment (Day 0) and at the end of the experiment (Day 28).*

Group	Animal ID	Sex	Age (weeks)	Weight (g) Day 0	Weight (g) Day 28
Control	1	Female	5	18	26
Control	2	Male	5	24	34
Control	3	Male	5	20	28
Control	4	Male	8	30	40
Control	5	Male	6	21	33
Control	6	Female	4	16	25
Treatment	7	Male	7	22	29
Treatment	8	Female	5	17	26
Treatment	9	Female	5	18	23
Treatment	10	Male	5	25	30
Treatment	11	Female	5	20	27
Treatment	12	Female	10	24	28

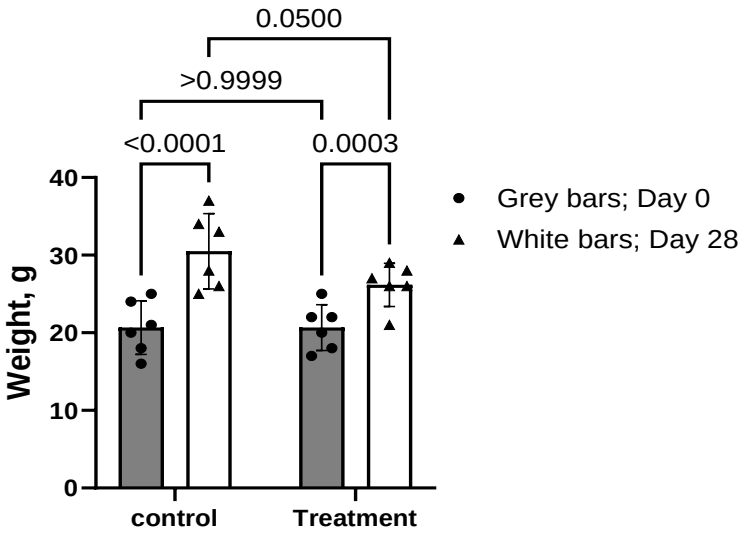

***Figure 1. Effect of Exobese™ on weight-loss in mice**. The grey bars indicate the mean mouse weight (+/- SD) at day 0 and the white bars indicate the mean weights (+/- SD) at day 28. The black circles and triangles indicate individual weight measurements. Statistical significance testing was performed using repeated measures two-way ANOVA and multiple comparisons. The p-values for the multiple comparisons are indicated within the figure for each pairwise comparison.*

***Table 2. Weekly Food consumption**. The experimental animals were placed in cages according to treatment group and sex (control and treatment animals in different cages, and females and males for each group into different cages. The amount of food consumed weekly, per cage is reported.*

Cage	*Number of animals in cage*	*Food consumed week 1*	*Food consumed week 2*	*Food consumed week 3*	*Food consumed week 4*	*Food consumed, total*
Control, females	*2*	*42g*	*46g*	*46g*	*48g*	*182g*
Control Males	*4*	*110g*	*114g*	*120g*	*124g*	*468g*
Treatment, females	*4*	*86g*	*90g*	*90g*	*95g*	*355g*
Treatment males	*2*	*48g*	*50g*	*60g*	*68g*	*226g*

Pilot study 2: Anti-microbial effects and cell toxicity of a novel bioactive compound

In this study, the anti-microbial effects of a novel compound derived from a marine microorganism was tested using an *in vitro* assay to establish the Minimum Inhibitory Concentration (MIC) against an isolate of *Staphylococcus aureus*. Additionally, to attain some preliminary data on the safety of the drug compound, an in vitro cell toxicity test was performed using the Human Embryonic Kidney cell line, HEK293T.

Antimicrobial (MIC) assay procedure:

For the MIC assay, bacteria of the strain *Staphylococcus aureus* were plated into well columns 1-10 of rows A-C and G-H on a 96-well plate. Then a 1:2 dilution series, starting from 8 µg/ml of a control antibiotic, Vancomycin (rows A-C), and the test drug compound (rows F-H) were added to the plate in triplicate at the indicated 10 dilutions (See schematic below in Figure 2). The 96-well plate was incubated for 24h. After incubation, the bacterial growth was observed in the wells, and the observations were noted down schematically in the 96-well plate map according to the density/size of bacterial pellet visible in the respective wells (Figure 2).

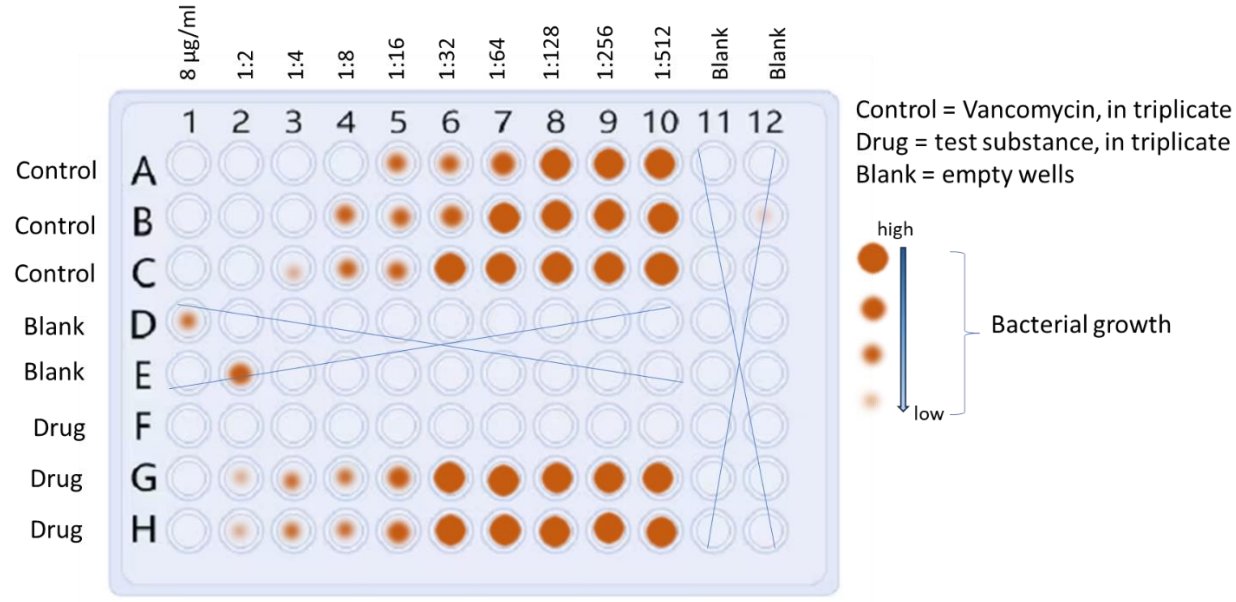

***Figure 2. Plate map for MIC assay and schematic illustration of the observed results**. The bacterial pellets observed are visualised as orange circles in the wells, corresponding to the size of the observed bacterial pellet on the 96-well plate. Rows D and E, as well as columns 11 and 12 were left empty (indicated as 'blank' and crossed over on the plate map). Each concentration for control and test drugs were plated in triplicate.*

Cell toxicity test:

The *in vitro* cell toxicity test was conducted using a cell toxicity assay kit from Abcam https://www.abcam.com/products/assay-kits/cell-cytotoxicity-assay-kit-colorimetric-ab112118.html). The cell line HEK293T was used for the experiment.

Experimental procedure: HEK293T cells ($1x10^3$ cells/well) were plated into 12 wells of a 96-well plate, in 100µl cell suspension / well. Then 100µl of the antimicrobial compound, diluted to a concentration of 16µg/ml in a solvent (undiluted DMSO), was added to 6 of the wells. The remaining 6 wells containing HEK293T cells were left as controls. The cell plate was incubated for 24 h in the cell incubation chamber.

After 24h, the cell toxicity reagent was added according to manufacturer's instructions and the cells were incubated for another 6h before analysis using a microplate reader. The achieved absorbance results (Table 3) indicate relative cell toxicity. The absorbance data is analysed and presented as a bar graph (Figure 3). A statistical analysis, using the 1-tailed Student's t-test gave a p-value of 0.0036.

***Table 3. Absorbance measurements for cell toxicity test**. Control wells contained untreated HEK293T cells, and the treatment wells contained HEK293T cells incubated with a 16µg/ml dilution of the drug (in DMSO) for 24 h. The absorbance was measured at 570nm, according to manufacturer's recommendations.*

Group	96-well position	Absorbance
Control	B2	0.55
Control	B3	0.80
Control	B4	0.65
Control	B5	0.60
Control	B6	0.54
Control	B7	0.40
Treated	C2	0.35
Treated	C3	0.40
Treated	C4	0.24
Treated	C5	0.50
Treated	C6	0.40
Treated	C7	0.35

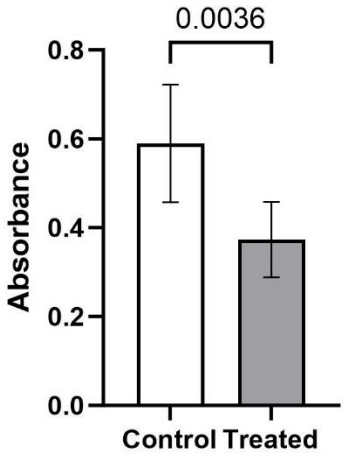

Figure 3. Relative cell toxicity*. The bars represent mean relative absorbance +/- SD for untreated control cells (white bars) and treated cells (grey bars. P=0.0036, as calculated using the one-tailed Student's t-test.*

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End of assessment

[Total 100 marks]

Assessment criteria

Below is an overview of what a fail, pass or distinction for this assessment will look like:

F: Generic content and/or incorrect, inadequate, or poor interpretation of results., poor inadequate or illogical description of the proposed experimental designs, failure to identify experimental shortcomings and provide appropriate experimental improvements or scientific justifications for the suggested design and analysis. Poorly structured or incoherent text or missing significant elements in the report. Inadequate or irrelevant references.

Note that a report marked as F3-F6 will contain most of these shortcomings, whilst an F1-F2 may contain only some of the shortcomings or errors stated above.

P_{low} = Adequately described results showing a sound ability of critical scientific review. Mostly just minor errors or missing minor details in interpretations, experimental design, and explanations. Logical and adequately described experimental design and data analysis, although may lack some in-depth understanding of some aspects of data analysis or experimental design, or inability to clearly justify all aspects. Scientific references/discussion are overall appropriate, showing a fundamental understanding of all experiments and results.

P_{high} = Well structured, correct and clearly described content, applying a good critical review with justified and clearly explained scientific basis. A critcally reviewed and well described and appropriately justified experimental design and data analysis, although some elements may be described only superficially. All scientific references/discussion are relevant and I appropriate, showing a good level of understanding of all experiments, results, and data analysis.

D_{low} = A thorough critical analysis applied to all results, analysis and experimental designs. Scientifically sound interpretations of results as well as ability to extrapolate information, draw conclusions and troubleshoot. Well justified and clearly explained experimental design, demonstrating a good understanding of experimental setup, statistics, and data analysis. A thorough and critical review of data and experimental setup, evidencing a sound scientific understanding throughout. Some In depth analysis of results and ability to identify experimental weaknesses and provide appropriate and justified solutions to improve robustness and data analysis where needed. Any literature references and scientific discussions overall are highly relevant, appropriate, and well-articulated.

D_{high} = A thorough critical analysis applied to all results, analysis and experimental designs. Scientifically sound, justified, and insightful interpretations of results and demonstrating the ability to extrapolate information, draw conclusions and troubleshoot. Very well justified, appropriately detailed, and clearly explained experimental design, demonstrating a high level of understanding of experimental setup, statistics, and data analysis. A thorough and critical review of all data and experimental setup, evidencing a high level of scientific understanding throughout. In depth analysis of results and ability to identify experimental weaknesses and provide appropriate and justified solutions, to optimize robustness and data analysis. All literature sources and scientific discussions are highly relevant, appropriate, and well-articulated. Demonstrates a high level of scientific understanding of the scientific topic, experimental setup, analysis, troubleshooting, challenges, significance etc. throughout the report.