Task 1 – “True Survivors”

What is it all about?

In the first part of the competition you will investigate one interesting aspect of the differentiation or the behavior of a little weird animal called brine shrimp (*Artemia ssp*).

The goal of this experiment

Show us that you can conduct a scientific investigation independently. We would like to see if you are able to figure out an experiment by yourself, do it and finally analyze your results before going ahead with the conclusions. It is crucial to first read some information about the creatures you will investigate and - in addition - about the procedure of such an assessment.

As you will see, your teacher is welcome to support you as an *adviser* only during the process of defining the design of your experiment. She or he is not supposed to support you during your investigations.

Before you do anything else, please read ALL instructions for ALL parts (1-5) carefully! You will find clear instructions on how to proceed during your investigations (see also aspects 1 - 3 for parts 3-5). At the end of this document you will find the scoring list with the evaluation criteria.

What you have to do…

Part 1

Getting some background information: Studying the literature

Search for information about brine shrimps. Try to find out as much as possible. To get your first points you will have to write a **short** text about the relevance of these - at first view - unspectacular arthropods. Try to integrate the following aspects:

A Brine shrimps in sciences. Why may they be of interest in respect of **physiology**, **developmental biology** and **ecology**?

B How do brine shrimps help us understand the secret of life? (No water no life – and still alive?)

The text should not be longer than 2/3 of an A4 page (**fewer than 2500 characters, including spaces**).

An important aspect will be the citation of your sources and establishing a bibliography (reference list) at the end of your paper. Please read the following instructions on how to cite carefully and use the examples as a model for your own list:

„In-text“ citations: Superscripted numerical markers

To let the reader know where you have used a piece of information in your work, please use the superscripted numerical marker. Here is an example:

“Monkeys prefer ripe bananas to unripe bananas[(1)]. This is due to the extra sugars present in ripe bananas[(2)], and scientists think that monkeys may have a similar range of tastes to humans[(3)]. It has yet been unproven whether or not monkeys find it funny when someone slips and falls on a discarded banana skin[(1)].

Bibliography (reference list)

Supply complete details of the source you have used – so that the reader could easily find it to check it or to learn more. Add the bibliography at the end of your documentation on page 12. You must list your sources in the order in which they appear in your documentation. The very first source you cite in your text is listed in position 1 in your bibliography, the second in position 2 and so on. If you use a source again later on, cite it in the text with the same number as the first time you used it. You don’t need to write the same source twice in your bibliography. Here an example referring to the “in-text” citations above:

1. Taylor, S. 2006. *Monkey Nutrition Handbook*. 2nd edition. pp. 198-199. Primate Press, Bandung.

2. Triandafillou, A. 2011. *Livestrong* – Article: “Nutritional difference in ripe bananas”. Retrieved February 22, 2013 from www.livestrong.com.

3. Murphy, R. et al. 2005. “A Study into the taste pallet of primates”. *Monkey Journal*, vol. 2, issue 12. Dec. 2005. pp. 12-15.

Part 2
Brine shrimp cultivation and three pretests

- The first goal is to establish as quickly as possible a functioning system to grow brine shrimps successfully. The parcel you received about two weeks ago contains all tools to start your cultures. **Avoid wasting time in the very beginning of your experiments**. Our creatures need time to develop! You may have already started with raising these animals.
  In order to support you when you start cultivating your brine shrimps, a little booklet for kids about breeding and investigating brine shrimps is included in your material box. Unfortunately, this booklet is available only in German and not in English, French or Italian. However, somebody in your class will be gifted in languages and will be able to support you or you might ask your German teacher. In addition, the pictures should help you a lot.

- Take **two** pictures: one picture of your brine shrimp lab including your upbringing system and one picture through your microscope or your binocular eyepiece, using your new camera system, showing us a brine shrimp at its best.

- Keep your brine shrimps in an adequate container, aerating the saltwater possibly by an air-pump. Try to establish a system that will provide you with enough shrimps for your investigations.
  Even if you change the conditions in which your brine shrimps are growing up and a lot of them finally die, please never forget that you are dealing with living animals and that they deserve your respect.

- During this part of the competition you have to fulfill three **pretests**. In the end you will most likely choose one of these pretests and develop it further to design your main experiment. Think carefully about interesting questions. Get inspired by the literature. Your creativity will make an impact!
  Make sure that you choose a promising aspect to investigate. What we expect to receive is:

  For each of the three pretests: Title, short description of the idea (1-2 sentences), sketch & meaningful picture of your setup and first (qualitative) results (max. 2 A4 pages in total for the three pretests).

- Take your time to share your ideas with your biology teacher. Your teacher may support you in finally establishing an interesting design for your investigations. As soon as you have decided on what to investigate, your teacher is not allowed to support you anymore.

Part 3
Design of your main experiment

We are looking for visionary and fancy ideas. Choose the most promising pretest and develop it further into the design of your main experiment. How can brine shrimps realize what's going on, how do they react to certain stimuli? How is their development influenced by different conditions? How could the observations be quantified? To prove something, you need enough data. A clever design allows you to get the data you need. Your experiment should **not be too complicated to conduct**. Please consider that it is important to repeat your experiment and to analyze your results in time. As mentioned above, every conclusion is based on enough data and a simple statistical analysis.

Think carefully about an interesting question. Think about quantifying your results. How can you measure what you want to investigate?

A design is made not only by describing an experiment by words, we would appreciate to see sketches and tables. Give us a short insight into your evolving ideas.

Aspect 1: Defining the problem and selecting variables

- **You should now identify and write down a specific research question**.
- Define and describe the three types of **variables**. Variables are factors that can be measured and controlled.
  Independent variables are those that are manipulated, and the result of this manipulation leads to the measurement of the dependent variable.
  A controlled variable is one that should be held constant so as not to obscure the effects of the independent variable on the dependent variable.
- Example of a specific scientific research question: 'How does the speed of movement of chloroplasts in *Elodea* cells vary with light intensity?' The independent variable is the light intensity; the dependent variable is the speed of movement. Relevant controlled variables would include temperature, preparation of *Elodea* cells, sample size and light quality.

Aspect 2: Controlling variables

- Describe carefully how the control of the variables is achieved (Materials and methods).
- If a standard measurement technique is used, it should be referenced.
- Input: While planning an investigation to study the effect of light wavelength on the rate of photosynthesis in *Cabomba*, you may have adapted a method to measure the rate of photosynthesis taken from a textbook. A standard citation would then be expected as a reference, for example, "Freeland, PW (1985) *Problems in Practical Advanced Level Biology*, Hodder and Stoughton".

Aspect 3: Developing a method for data collection

- The planned investigation should provide sufficient data so that the research question can be suitably addressed and an evaluation of the reliability of the data can be made.
- Be sure to collect enough data in part 4 to enable an error analysis that involves the calculation of a mean value and a standard deviation.

Part 4
Data collection and processing

In parts 1-3 you have collected a lot of information about brine shrimps and made a design for your experiment you are going to conduct. Now it's time to transfer your idea into a setup for a challenging experiment. You may feel what it means to be a scientist ☺.
It is absolutely crucial to collect enough and reliable data!

Aspect 1: Recording raw data

- Raw data are the actual data measured.
- Within tables of quantitative data, columns should be clearly annotated with a heading, units and an indication of the uncertainty of measurement. The number of significant digits should reflect the precision of the measurement.

Aspect 2: Processing raw data

- Data processing involves, for example, combining and manipulating raw data to determine the value of a physical quantity (such as adding, subtracting, squaring, dividing), or taking the average of several measurements and transforming data into a form suitable for graphical representation. It might be that the data are already in a form suitable for graphical presentation. If the raw data are represented in this way and a best-fit line graph is drawn, the raw data have been processed. Plotting raw data (without a graph line) does not constitute data processing.

Aspect 3: Presenting processed data

- You are expected to decide upon a suitable presentation format yourself (for example spreadsheet, table, graph, chart, flow diagram and so on). There should be clear and unambiguous headings for calculations, tables or graphs. **Graphs need to have appropriate scales, labeled axes with units, and accurately plotted data-points with a suitable best-fit line or curve (not a scatter graph with data-point to data-point connecting lines).** You should present the data in a way that all the steps to the final result can be followed. The way you present your data is not only a matter of design. It should be meaningful and prove that you didn't choose the type of diagram by chance.
- You should include a treatment of uncertainties and errors with your processed data, wherever relevant.

Part 5
Conclusion and evaluation

You have now acquired your data. How to proceed? It is up to you to find an interpretation.

Although your results may seemingly fit your hypothesis, be prudent in concluding and try to reconsider premature deductions. Nevertheless – this part may be very satisfactory ☺.

Aspect 1: Concluding

- Analysis may include comparisons of different graphs or descriptions of trends. The explanations should contain observations, trends or patterns revealed by the data.

Aspect 2: Evaluating procedures

- The design and method of the investigation must be analyzed as well as the quality of the data. You must not only list the weaknesses but must also appreciate how significant the weaknesses are. Comments about the precision and accuracy of the measurements are relevant here. When evaluating the applied procedure, you should especially look at the processes, use of equipment and time management.

Aspect 3: Improving the investigation

- Suggestions for improvements that could be made in a future experiment should be based on the weaknesses and limitations identified in aspect 2. Modifications to the experimental techniques and the data range can be addressed here. The modifications proposed should be realistic and clearly specified. It is not sufficient to state generally that more precise equipment should be used.

Most of the aspects in part 3-5 are based on the “IBO Diploma Programme Biology Guide”, 2009. International Baccalaureate Organization, Peterson House, Malthouse Avenue, Cardiff Gate, Cardiff, Wales GB CF23 8GL, United Kingdom, www.ibo.org.

Scoring List

Part	Subject	Score (%)
1	Searching the literature, background information (For your short text and the correct references to the literature you can get 10% of the total score).	10
2	Pretests (For two pictures of your brine shrimp lab with your upbringing system and for establishing and evaluating three promising experimental ideas, providing the expected data for each approach (title, short description of the idea (1-2 sentences), sketch & meaningful picture of your setup), you can get 20% of the total score) *	20
3	Design (If you fulfill all 3 aspects perfectly you will get 15% of the total score).	15
4	Data collection and processing (If you fulfill all 3 aspects perfectly you will get 20% of the total score).	20
5	Conclusion and evaluation (If you fulfill all 3 aspects perfectly you will get 15% of the total score).	15
Layout	Layout of your documentation (If all pictures and tables are labeled and numbered correctly and the quality of your charts and diagrams is convincing, if your layout is pleasant and consistent, you will get 10% of the total score).	10
Extra Points	Extra points for a fancy and exciting approach (You will get these extra-points (10% of the total score) if you convince us with a unique, interesting idea that finally leads to a successful investigation and meaningful results).	10
Total		100

***** Send us your most impressive picture of a brine shrimp if you want to be part of the additional and optional photo competition “Miss Artemia”.

Don’t forget…

Reference List
List your **references** at the end of your documentation on page 12 according to the guidelines explained in Part 1.

Activity List
Add the **activity list** to your documentation! Each class needs to report which member was or is responsible for which portion or aspect of the work. Each person in the class must have participated at least once (during the entire competition) in the experimental portion. Therefore, **take 2 digital photos showing the class involvement.** Place them next to the activity list in your documentation file at the very end.

Expected documentation and further information

- Create **one single** PDF file (the size of the PDF file must not exceed **6 MB**!) containing all your answers, solutions, pictures, other documenting material and the activity list. Use page numbers and use a new page at the beginning of each part:

  Front page: name of school, name of class and number of task
  Page 1: Table of Contents
  Page 2: Part 1
  Page 3-5: Part 2
  Page 6: Part 3
  Page 7-10: Part 4
  Page 11: Part 5
  Page 12: Reference List
  Page 13: "Activity List" including two pictures

- Use font size 11.
  You are free to choose the font, but it should be easily readable.

- Name the file following strictly these conventions:

  1. Name of School

  2. Name of Class (same as on application form or homepage)

  3. Number of Task

  4. Date (year/month/day)

  → Please use underlines instead of spaces!

  Here is an example: **Kantonsschule_Muster_Class3b_Task1_20150308.pdf**

Closing Date of Task 1: Friday, 27.3.2015, 23.59h