**Internal Assessment Criteria – with Checklist**

\*\*The rubrics on these pages need to be consulted each time a lab is being submitted for internal assessment. These guidelines will be used by the teacher to calculate lab marks in both Grade 11 and Grade 12, and are the same as those used by IBCA for labs being submitted for moderation\*\*

**Personal Engagement**

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| Mark | Descriptor |
| **2** | **The evidence of personal engagement with the exploration is clear with significant independent thinking, initiative or insight.*** Assessed throughout report. Includes aspects of creativity and “making it your own”.

**The justification given for choosing the research question and/or the topic under investigation demonstrates personal significance, interest or curiosity.*** *Background* paragraph about what led you to your research question and/or reasons for your interest in the dependent and independent variables, like Science Fair in Grade 9. Also include a description of any preliminary investigation that steered you toward your research question.

**There is evidence of personal input and initiative in the designing, implementation or presentation of the investigation.*** Assessed throughout report. Includes aspects such as preliminary testing (should be part of the *Background* or *Procedure*) and thoughtful extensions/improvements in the *Evaluation*.
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**Exploration**

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| Mark | Descriptor |
| **5-6** | **The topic of the investigation is identified** (“clearly”) **and a relevant and fully focused research question (RQ) is clearly described.*** RQ clearly stated and concise.
	+ Independent variable (IV) correctly identified with units and range.
	+ Dependent variable (DV) correctly identified, as directly recorded, with units. (Statement may be made if further calculations need to be performed on DV, but not means, standard deviation, etc.)

**The background information provided for the investigation is entirely appropriate and relevant and enhances the understanding of the context of the investigation.*** *Background* paragraphs to investigation are “appropriate to the Diploma Programme level”, including:
	+ factors that affect the dependent variable of interest (with references).
	+ reason(s) why dependent variable and independent variable (factor) were chosen.
	+ scientific names of any organisms used in the investigation.
	+ any special equipment needed to vary or measure variables.
	+ explanations of any scientific terms or concepts essential for understanding the investigation.
* *Research Hypothesis* predicts relationship between DV and IV (If…then…because…).
	+ Prediction explained using scientific theory.
	+ Sources are referenced appropriately (assessed in Communication).

**The methodology of the investigation is highly appropriate (“**to the Diploma Programme level”**) to address the research question because it takes into consideration all, or nearly all, of the significant factors that may influence the relevance, reliability and sufficiency of the collected data.*** Variables section includes outline of IV, DV and all relevant control variables (CVs).
	+ Each condition/increment of IV stated and brief explanation of why this range was chosen (*ie*. large enough range).
	+ Repeat of DV (from RQ) and how it will be measured.
	+ Brief explanation/potential impact included about why the CVs need to be kept constant or monitored. (How these will be controlled should be in the Procedure.)
* Step by step Procedure to manipulate IV includes specific detail of changing increments precisely.
* Consider (think about) which results must be collected that will be transformed into processed data for graphing and/or comparison in the Analysis.
* Materials and Procedure includes requirements for precise recording of DV results, including units and uncertainty as appropriate (±\_\_\_)
* Procedure refers to annotated diagram (or photo) of complex equipment set-up (if helpful).
* Reference for published protocol, if used.
* Procedure specifies how to keep each CV constant, including recording measured values using equipment needed to keep a variable constant.
* 2-5 increments / conditions over a suitably large range for the IV dependent on the nature of the investigation, including difficulty of gathering data.
* Minimum 10 trials/repeats at each increment to ensure reliability.
* State which specific/relevant qualitative data should be collected (eg. colour, state, gender, etc.)
* Consider if Procedure is specific and clear enough to be easily repeated by a non-Biologist.

**The report shows evidence of full awareness of the significant safety, ethical or environmental issues that are relevant to the methodology of the investigation.*** Potential risks waiver for human investigations stapled to back of report.
* Safety/ethical/environmental concerns addressed, including animal experimentation policy.
* Appropriate disposal of waste and/or live specimens to prevent environmental contamination.
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**Analysis**

This criterion assesses the extent to which the student’s report provides evidence that the student has selected, recorded, processed and **interpreted** the data in ways that are relevant to the research question and can support a conclusion.

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| **Mark** | **Descriptor** |
| **5-6** | **The report includes sufficient relevant quantitative and qualitative raw data that could support a detailed and valid conclusion to the research question.*** All data are recorded precisely in titled tables (and sometimes figures), correctly and honestly (raw data is signed).
* Relevant qualitative data (observations) MUST be recorded or not at all/0 awarded.
* Decimal places recorded consistent with precision of the measuring equipment.
* Self-explanatory and numbered titles and headings written for tables and figures (assessed in Communication (Comm)).
* Raw data clearly distinguished from processed data, use separate tables as appropriate. Generally, processed data must be presented in the Analysis section.
* Have original sheet of observations signed/copied by the teacher and submitted with lab report, and that it matches data tables.

**Appropriate and sufficient data processing is carried out with the accuracy required to enable a conclusion to the research question to be drawn that is fully consistent with the experimental data.*** Calculations to determine IV and DV carried out as appropriate to the investigation.
* One worked sample calculation given for each type.
* Variables/symbols defined for each calculation.
* Sample numbers included, as appropriate, with units and correct precision where significant digits (eg. decimal places) are consistent with recorded data.
* Mathematics correctly applied
* Sample t-test or chi-squared test includes a H0
* Date-stamped (sample) printout of a t-test that matches the sample calculation included at the back of report.
* Website-calculator referenced appropriately (Comm).

**The report shows evidence of full and appropriate consideration of the impact of measurement uncertainty on the analysis.*** Units of IV, DV, CV correctly recorded in headings with correct uncertainties (±\_\_\_\_\_\_)

**The processed data is correctly interpreted so that a completely valid and detailed conclusion to the research question can be deduced.*** Numbered titles and headings written for tables and figures (Comm).
* Units and uncertainties/ errors included as appropriate (Comm).
* Consistent decimal places within each table column (Comm).
* Choice of graph type is appropriate, with bars / best-fit line / trendline.
* Graph axes labeled clearly, including metric/SI units and uncertainties of values (Comm).
* Axes scaled appropriately.
* Error bars correctly included on any graphed means.
* Error bar source (*eg*. standard deviation) stated.
* Tables and graphs do not break across pages; graphs min ½ page (Comm).
* Graphs clear, with colouring and legend, as appropriate.
* Complete summary table for statistics, including correct critical values.
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**Evaluation**

This criterion assesses the extent to which the student’s report provides evidence of evaluation of the investigation and the results with regard to the research question and the accepted scientific context.

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| **Mark** | **Descriptor** |
| **5-6** | **A detailed conclusion is described and justified which is entirely relevant to the research question and fully supported by the data presented.*** Make a clear conclusion that addresses the research question or hypothesis – to what extent is it supported? There is no need for a detailed summary of how the investigation was carried out.
* Appropriate language used “supports the hypothesis” (not ‘proves’ or ‘is correct’)
* State patterns and trend(s) in data, keeping in mind the overall conclusion, by referring to all tables and figures, including:
* Raw data (as presented in the Observations section) and relevant qualitative data, as appropriate.
* Means and variability, *ie.* standard deviation size compared to difference between the means and/or overlap of graphed error bars on means.
* Refer to actual t-test and critical values. Group these into those that were significant and those that were not.
* Explain t-test results, including random variation allowed in p=0.05.

**A conclusion is correctly described and justified through relevant comparison to the accepted scientific context.*** Comparison, *ie.* scientific explanation, of results using published data and theoretical texts .
* Sources are referenced appropriately (assessed in Communication).

**Strengths and weaknesses of the investigation, such as limitations of the data and sources of error, are discussed and provide evidence of a clear understanding of the methodological issues\* involved in establishing the conclusion.*** The actual effect of specific trials – with reference to the data table(s) – on the mean(s), and t-value are discussed, which are examples of:
	+ Anomalous data (*eg.* outliers) and/or qualitative data that points to problems with the reliability or even validity of the conclusion
	+ Particularly high variability of results, *ie.* very large standard deviations (error bars)
	+ Inappropriateness of the range of IV values with regard to the Purpose/RQ or other systemic limitations of the investigation/procedure/method.
	+ Measurement/instrument/time limitations that cannot otherwise be eliminated with effective lab skills.

**The student has discussed realistic and relevant suggestions for the improvement and extension of the investigation.*** Achievable by addressing the RQ quantitatively (*eg.* improving control of IV, DV, and CV)
* Specify additional steps, the purpose of which are clearly explained.
* Cite references where information and improvements relate to published protocols or techniques.
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**Communication**

This criterion assesses whether the investigation is presented and reported in a way that supports effective communication of the focus, process and outcomes.

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| **Mark** | **Descriptor** |
| **3-4** | **The presentation of the investigation is clear. Any errors do not hamper understanding of the focus, process and outcomes.*** Proper spelling, grammar, syntax, *etc*.

**The report is well structured and clear: the necessary information on focus, process and outcomes is present and presented in a coherent way.*** Sections in order and logical flow of information within each section.

**The report is relevant and concise thereby facilitating a ready understanding of the focus, process and outcomes of the investigation.*** 12 pages or less overall, but being concise also includes writing with an appropriate level of detail and without being *unnecessarily* repetitive.

**The use of subject-specific terminology and conventions is appropriate and correct\*. Any errors do not hamper understanding.*** Self-explanatory titles for the overall report, tables (including list of headings), and figures that include the independent and dependent variables and the context of the investigation (eg. organism, group characteristics, etc).
* The title bar/page must not include your name: use your IB personal code (XXX###), *eg*. yrf416; however filenames for submission to Turnitin must include your full name.
* Appropriate decimal places (*eg.* significant digits only) throughout *Observations* and *Analysis*, and units shown in table headings (not with each value) and in sample calculations.
* Sufficient and appropriate labels for figures (*eg.* graphs, images, *etc*.) with units as necessary.
* Sources referenced consistently using an accepted format.
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\*For issues of referencing and citations refer to the “Academic honesty” section (IB Diploma Programme, Biology Guide).