

	Lab journals	5	4	3	2	1
Structured communication 1: Structure/Clarity/Language	Students are able to communicate their research and that of others in a structured and catchy manner, both written and verbally.	Structured layout: all instructions concerning the layout have been met: all headers are marked, all figures have clear and extensive captions, figures have a clear position, concise & clear formulation, correct use of scientific jargon, academic use of language . Time of most measurements is noted, clear distinction between measured data and theory, all references have been made where necessary.	Structured layout: all instructions concerning the layout have been met: all headers are marked, all figures have clear and extensive captions, figures have a clear position, clear formulation , correct use of scientific jargon . Time of some measurements is noted, distinction between measured data and theory, all references have been made where necessary.	Structured layout: almost all instructions concerning the layout have been met: most headers are marked, most figures have clear captions, figures have a clear position , mostly clear formulation , some references have been made where necessary .	Structured layout: several instructions concerning the layout have been met: some headers are marked, some figures have captions.	No or very little structured layout.
Structured communication 2: Data presentation		Clear presentation of all data revealing patterns and features in the data : neat tables and graphs including error bars, names for axes, consistent use of units, clear definition of all symbols in formulas, end results are correctly rounded and accuracy is presented correctly.	Clear presentation of most of the data: neat tables and graphs including error bars, names for axes, consistent use of units, definition of most symbols in formulas, end results are correctly rounded and accuracy is presented correctly.	Clear presentation of important data: neat tables and graphs including error bars , names for axes, consistent use of units, end results are correctly rounded .	Tables and graphs are used to present data including names for axes , most units are present.	Data is presented unclearly .
Structured communication 3: Argumentation		Arguments are written concisely and are complete .	Most arguments are clear.	Some clear arguments are given.	Arguments are vague/unclear or too short/unnecessarily long.	Arguments are vague/unclear and too short/unnecessarily long .
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Trustworthy results 1: Setup	Students are able to independently execute their measuring plan, adapting it where necessary to collect trustworthy results from an experiment while clearly documenting their steps.	Contains clearly understandable visual and description of a creative or clever final and intermediate experimental setups including a complete description of used materials and all critical parts , critical aspects are discussed .	Contains clearly understandable visual and description of the final experimental setup including a complete description of used materials.	Contains visual and description of the final or intermediate experimental setup including a complete description of used materials .	Contains visual or description of experimental setup or a reference to that part of the measuring plan.	Contains no or a very limited visual or description of experimental setup.
Trustworthy results 2: Measuring method		Contains a creative or clever and complete retraceable execution of how the measurement plans have been implemented in practice, containing all essential steps and settings, discusses the spread of measurements, what has been varied in which range and how that variation has been controlled, and what has been kept constant , including remarks on how all discrepancies between plan and practice have been resolved, updated task risk analyses when necessary not containing any unnecessary risks , including how raw data errors have been determined.	Contains a retraceable execution of how the measurement plan has been implemented in practice, containing most essential steps and settings , discusses the spread of measurements , and what has been varied and how that variation has been controlled , including a remark on how some discrepancies between plan and practice have been resolved , updated task risk analyses when necessary, and how raw data errors have been determined .	Contains how the measurement plan has been implemented in practice, containing several essential steps , and what has been measured , including a remark on the practical implementation of the measurement plan and updated task risk analyses when necessary .	Contains a measuring method or a reference to the measuring plan.	Contains no or a very limited measuring method.
Trustworthy results 3: Test results		Contains how the setups were tested and quick test results for all variables.	Contains how the setup was tested and quick test results for most variables.	Contains quick test results for an important variable.	Contains quick test results for a variable.	Contains no test results for variables.
Trustworthy results 4: Measurement optimization		Contains creative optimization of all measurements, e.g. calibration, as precise measurements as possible containing as little noise as possible.	Contains optimization of most measurements.	Contains optimization of some measurements.	Contains very limited information on optimization of measurement.	Contains no information on optimization of measurement.
Trustworthy results 5: Measurement errors		Contains all important measurement errors and remarks on the size of all of them plus decisions about continuation of measuring .	Contains all important measurement errors and remarks on the size of several of them.	Contains most measurement errors.	Contains very limited measurement errors.	Contains no measurement errors.
Trustworthy results 6: Results & Productivity		Contains proven outstanding productivity (where possible extra observations are made) , contains only quantified remarks. Some resulting data can be a useful starting point for publication .	Contains proven above average productivity (some extra observations) and some quantified remarks.	Contains proven adequate productivity (no extra observations) and some quantified remarks.	Contains adequate productivity (no extra observations) and only descriptive remarks.	Contains inadequate productivity (no extra observations or descriptive remarks).

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Critical Analysis 1: Interpretation of data	Students are able to independently execute their analysis plan, adapting it where necessary to critically analyse an experiment while clearly documenting their steps.	Logically correct interpretation of the data using theory: every result is critically discussed, in the case of unexpected results the cause is discussed.	All data is correctly interpreted: some results are critically discussed, unexpected results are reinvestigated .	Most data is correctly interpreted: some results are critically discussed .	Some correct interpretation of the data: results are not critically discussed.	Incorrect interpretation of the data: results are not critically discussed.
Critical Analysis 2: Application of theory		Building on existing scientific theories: a broad knowledge of current scientific theory is applied correctly and quantitatively to the data within the correct restraints. No irrelevant theories are mentioned.	Thorough knowledge of current scientific theory is used in analyzing all data. No irrelevant theories are mentioned.	Sufficient knowledge of scientific theory is used in analyzing most of the data. No irrelevant theories are mentioned .	Some scientific theory is used in analyzing some of the data.	No or very limited scientific theory is used in analyzing the data.
Critical Analysis 3: Error analysis and fits		The size of all statistical and systematic errors and fits are critically and quantitatively discussed concerning their influence on the conclusions .	The size of most statistical and systematic errors and fits are discussed.	The size of most statistical or systematic errors or fits are discussed.	The size of some statistical or systematic errors or fits are discussed.	The size of statistical and systematic errors and fits are not critically discussed.
Critical Analysis 4: Raw data to conclusions		Conclusion summarizes all main findings , answers each (sub) research question and hypotheses are tested quantitatively and correctly , the creative or clever line from raw data to conclusion is coherent, logical and clear, all end results are critically discussed, limitations are mentioned .	Most (sub) research questions are answered and the line from raw data to conclusion is clear , most end results are critically discussed.	Research question is answered and the line from raw data to conclusion can be traced, some end results are critically discussed.	Research question is answered or an end result is discussed . The line from raw data to conclusion can be traced somewhat .	Research question is not answered or the line from raw data to conclusion is not clear , or end results are not discussed.
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