CEITEC
MASARYK UNIVERSITY

Your Guide to Storing Laboratory Records – Lab Notebooks

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Editor / Reviewed by	K. Říha, Deputy Director for Science M. Pokorná, Deputy Director for Administration
Authors	N. Kostlánová, Scientific Secretary
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CONTENT

Dear researchers,

We would like to introduce you to a document that describes the procedures and principles for acquiring and storing records of your research activities at CEITEC MU, and to specify good practices, as well as the rules applicable for all researchers and scientists. This document aims to support all junior scientists in acquiring correct scientific habits, and can be used by their managing employees and supervisors as a guideline for fulling the binding Director's Measure, CEITEC MU No. 3/2020 "Acquisition and storing records of research activities at CEITEC MU."

The good quality of records for all research activities is essential for the processing, analysis, and publication of research data. This is fundamental for scientific cooperation and follow-up research activities. The disclosure of records may also be requested by editors during the review process when publishing scientific results, and proves the validity of published information in the event of allegations of falsification or other types of unethical behaviour. Recording scientific activities can also help to prove the origin of copyright in results with commercial potential, and is very important, especially in research involving human entities, as it prevents the disclosure of sensitive or personal data.

There is no desire to transform the existing systems of individual research teams, which operate in most workplaces, but to ensure a minimum standard of preservation of research records within our institution. This document provides not only guidance on how to implement the binding elementary principles summarised in Measure No. 3/ 2020, but also specifies ways to help set up good practices within research teams.

TIP: Do you want to be sure that your laboratory record keeping system is working? As a rule of thumb, go through your old lab notebook and evaluate whether it would be possible to repeat specific experiments, according to the individual records. If you are in doubt, or if you see a clear space for improving record acquisition and storage processes, you can use this document as a guide. For consultations on non-standard cases, please contact the Scientific Secretary of the Institute at: scientific.secretary@ceitec.muni.cz.

BASIC PRINCIPLES OF ACQUISITION AND STORAGE OF RECORDS OF RESEARCH ACTIVITIES AT CEITEC MU

The binding rules for the acquisition and storage of records of research activities are stipulated in CEITEC MU Measure No. 3/2020, “Acquisition and storage of records of research activities at CEITEC MU,” and are built upon the following elementary principles:

- All CEITEC MU employees and students, in all types/forms of study, including interns and visiting students whose supervisor or tutor is a CEITEC MU employee, are obliged to acquire and store the records of research activities;
- All information that arises in connection with research organised by CEITEC MU (i.e., directly on the premises of CEITEC MU, as well as outside (e.g., during service measurements performed in external facilities, internships in other laboratories, etc.)) must be recorded;
- The recorded information must be complete (i.e., inclusive of research data obtained during experiments, which should be treated according to Director´s Measure No 4/2020, “Research Data Policy”), accurate, sufficiently detailed, and comprehensible so that it can be used to repeat results;
- Records must be kept either in Czech or English;
- Records must be kept in a form and quality that allows them to be retraced and processed again in a long-term perspective;
- Lab notebooks are used for recording the activities of scientific results. The notebook’s form, manner of checking, and further storing is determined by the managing employee of the given research team i.e., Research Group Leader or Core Facility Head (hereinafter referred to as “managing employee”);
- Lab notebooks can be in a handwritten as well as electronic form;
- Each member of the team bears full responsibility for keeping records of their everyday research activities in the agreed-upon form of a lab notebook, which is regularly submitted to their managing employee for inspection;
- The completed lab notebooks must be submitted to the relevant managing employee that is responsible for their storage and keeping a list of the notebooks;
- All research activity records, other than contractual research, are in possession of CEITEC MU. Upon the termination of employment or studies of a particular employee, all lab notebooks must be submitted to their managing employee. Upon request, a particular employee may obtain a copy of such notebooks. If an entire research team is dismissed, the lab notebooks of all individual team members, includingthe list of them, must be submitted to the Scientific Secretary.

LAB NOTEBOOK

2.1. How to Carry out a Lab Notebook – Good Tips

A lab notebook is used to record all activities related to research at CEITEC MU. It contains both material things (e.g., gels, photographs, computer records, etc.), and non-material things, such as observations, hypotheses, conclusions, discussions, etc. The aim of the record is to reliably and completely monitor the development of the project, including the train of thoughts that determined the direction of development. It is also used so that it is possible to follow the direction of development at any point in the project so that it is not necessary to repeat previously performed experiments or to repeat any part of the project on the basis of the recorded parameters.

The lab notebook can be realised in the form of a record book or a workbook with hard or ringed binding, an electronic notebook, or a combination of written and electronic notebooks. Individual pages or records must be numbered in a continuous series of numbers. Records must be acquired and managed in such a way that prevents their destruction, loss, or any modifications. For electronic notebooks that do not use software that enables the daily validation of records, they must be stored in Masaryk University's institutional repository (private repositories are not allowed), which is secure and allows for regular automatic backup (e.g., CEITEC MU shared disks managed by the Information Technology Centre of University Campus Brno, or another repository of scientific data managed by the Institute of Computer Science at Masaryk University (ICS MU).

The record form may vary according to the specific needs of the project that is recorded, and according to field practices, nevertheless all records must be legible, clearly worded, complete, and thorough so that any repetition of the described activity is possible.

A lab notebook includes the following information:

- Identification of the researcher;
- Identification of the project;
- Identification of the lab notebook within a continuous series of lab notebooks managed by the particular research team, and
- Folder for materials that cannot be inserted directly into the lab notebooks (e.g., gels, records on various measurements, etc.). Such materials must be sufficiently described in the particular part of the lab notebook.

*TIP: To identify the researcher and the project, it is appropriate to use an **acronym**, in addition to the full name, which can be used in the following texts of the lab notebook. The project should also include information stating its source of funding.*

*TIP: The identification of lab notebooks should be set uniformly for the entire research team, so that the managing employee can keep good track of all active and closed notebooks. The marking of notebooks within one team can then look like: **711001-01-XY-A**, where the first group of digits defines the research team, followed by the two-digit number that indicates the notebook number, then the acronym of the researcher to whom the notebook belongs, and ends with the symbol of A (active) or C (closed). To ensure a sufficient overview, a **list of lab notebooks** should be kept that contains the following information: notebook identification (code), owner's full name, notebook publication date, notebook owner signature, notebook closing date, owner signature upon completing and handing over the notebook to the managing employee, signature of the managing employee upon receipt of the closed notebook, and the location where the notebook is stored.*

2.2. Rules for Recording in Lab Notebooks

A lab notebook is comprised of individual records that describe research activities that take place during a particular time period (usually one full day), which must follow each other continuously. It is not possible to skip pages in the notebook and then insert new entries into free spaces.

TIP: In the written notebook, please make corrections by crossing out the text with a horizontal line and then completing the correct information, making sure to include the date and your signature. Blank spaces in the record must be crossed off. Do not erase or make any existing text in the record invisible in any way.

For the electronic form of a notebook, it is possible to use standard text files or any applications for recordings, including those that use audio recordings. The electronic notebook contains the same information that would be recorded in the paper version of the notebook (i.e., all activities that took place during the project must be recorded). Once a record is created, it cannot be deleted. The electronic notebook must be regularly converted to PDF form and backed up.

TIP: The managing employee shall determine the frequency for generating the PDF form of notebooks. Ideally, it should be generated on a daily basis, as it eliminates the risk of back-editing the records.

Generally, the record should include the following information:

- Identification of the researcher;
- Detailed description of the experiment (i.e., what, when, and why something was done);
- Identification of the material used (there is no need to provide complete information on commercial products or methods; a relevant link should be sufficient);
- Experiment findings/results;
- Interpretation of the experiment findings/results, and

- Suggestions for further steps.

2.3. Rules for the Administration of Lab Notebooks within a Research Group / Core Facility

Within a Research Group or Core Facility, the concept of data acquisition and storage is determined by the managing employee, who can delegate specific activities to another employee. The concept must meet all conditions defined in Measure 3/2020. In addition, the managing employee shall determine:

- The form of the lab notebook to be used by the research team (either written or electronic), whereas a combination of both forms within one team is also acceptable;
- Specific requirements for the form and content of the records;
- System of validation and regular backup of lab notebooks, and
- The way to record electronic data and other outputs of research activities, that are not directly included in the lab notebook.

TIP: The form of the lab notebook should meet the specific practical needs of the researchers who use it. For researchers that do not primarily work in a "wet laboratory," it is not expedient to keep a written notebook, as most tasks will be electronic. Therefore, the lab notebook will be a list of acquired data files with sufficient commentary that captures the development of the experiment and other relevant information, which will then be used for qualification papers or the publication of results.

2.4. Recommendations for Various Types of Lab Notebooks

2.4.1. Lab Notebooks in Hardcover

A lab notebook in hardcover written form is a very popular recording tool that has the ability to record information in a simple and permanent way. Additionally, the tools needed (notebook and pen) to create a record are not dependent on external power sources, and are easily accessible and conveniently portable. At the same time, the strong binding enables good protection against forgery and other manipulations of records, thus providing effective control.

A disadvantage to using hardcover lab notebooks is the need to separately store other types of experiment outputs that cannot be described (e.g., photographs, measurement records, etc.) from the specific record of the experiment in which they were created. Therefore, they place a burden on the acquisition and management of external storage, an accurate system of registration of stored outputs, and their references to entries in the notebooks.

The duplicate saving of the notebook is only possible by digitising the record or making a copy, which is time-consuming and can lead to errors. It is also complicated to search through existing records. Moreover, the quality of the records depends on the graphomotoric and organisational skills of the person that is recording the notebook.

TIP: The CEITEC MU management encourages the hardcover form of lab notebooks, while using the CEITEC MU design and structure, numbered pages, and a structure that unifies the way the records are validated. If you wish to use lab notebooks in hardcover that bear the CEITEC MU logo, you can obtain them at the Director's Office (PR@ceitec.muni.cz).

2.4.2. Lab Notebooks with Loose Sheets

Lab Notebooks in spiral binding or ringed binding where individual sheets can be added or taken out (ringed notebooks), or in some cases, where the form of individual record sheets is inserted into a folder, have a major advantage in the ability to clearly and uniformly organise records, and to include other outputs of experiments (e.g., by adding gels in hole-punched pocket file folders directly to the record of experiment from which the gel originated).

It is quite difficult to make copies, maintain clarity, and carry out a record search in this form of notebook. In addition, the main disadvantage is the easy possibility of either intentional or accidental manipulation of the inserted records, which can lead to the devaluation of the experiment, as well as the entire project. This system, which allows for deleting or modifying records (so that it may not be obvious that the modification has taken place), does not have a desired value in copyright proceeding or in the case of the necessity to defend the measured data. Therefore, it is necessary to carefully consider the usage of this form. Individual sheets must be numbered, and in the case where a sheet needs to be removed/added, it must be properly explained in the notebook.

TIP: CEITEC MU management accepts this form of lab notebook. However, its usage is preferred to be used by senior researchers whose records are regarded as reliable and meet the required standards. This form of notebook is inappropriate for doctoral students and postdocs, who usually stay at CEITEC MU for a limited period, and therefore, a well-manged lab notebook will become a valuable review of their research activities.

2.4.3. Electronic Lab Notebooks

Electronic lab notebooks have become progressively popular for taking records and saving data. For this purpose, it is possible to use common text editors, as well as sophisticated applications that focus directly on the creation of a lab notebook.

Undoubtedly, the greatest advantage of electronic notebooks is the possibility to create well-arranged records that are easy to search, and can contain other outputs of the experiments that are produced in electronic form or are digitisable. Moreover, it is possible to easily duplicate lab notebooks, and if backups are stored in various places, it greatly reduces the possibility of completely losing records. Lab notebooks can be used in various and remote places, as well as be shared within the workplace.

The electronic form of lab notebooks is strongly advised, particularly for projects that require a certain degree of data anonymisation or their protection before they are published, as it is possible to use other applications that can provide data anonymisation or protection.

However, there are disadvantages as well. Manipulation during the creation of records in electronic lab notebooks is complicated, and there is also a high probability of software and hardware failures, which can lead to the destruction of records. The risk of records being stolen by internet pirates is also higher. Without a special application, it is very difficult to monitor and check whether the data have been subsequently modified or otherwise altered.

TIP: The CEITEC MU management suggests using existing applications for electronic lab notebooks that will allow for the effective conduct and monitoring of records, for both senior and junior researchers. Furthermore, it suggests that generated records are stored in two different types of repositories, which will significantly eliminate the loss of data.

TIP: In the case of electronic notebooks, it is also possible to use their audio form. The audio form of a lab notebook is beneficial because it is less time-consuming to create them. One disadvantage is the inadequate availability of the playback device, which makes it difficult for the record to be shared further. Nevertheless, we recommend that senior researchers use this form.

2.5. Electronic Data Records

As part of the experiments within a project, electronic data must often be kept together with the record of the experiment when it is created. The data must be kept in the original form in which it was obtained (i.e., raw data), as well as subsequent data that resulted from processing the original data. The Measure 4/2020 Research Data Policy further deals with specific rules of data storage at CEITEC MU (can be found HERE). Long-term data storage is based on the FAIR Principles, in which data must be *findable*, *accessible*, *interoperable,* and *reusable*. The Managing employee head of workplace decides on the data that **do not need to be stored** for a long time, especially due to the limited capacity of the repository.

E-data can be stored in various types of in-house, as well as external devices (e.g., on hard drives, memory cards, CDs, DVDs, and other secured external or shared (clouds) repositories). All types of repositories must enable the long-term storage of data and their retrieval. If data are in an unusual format, software that enables the data to be read must be attached as well. If access to the data is secure, the access passwords must be included in the lab notebook.

TIP: Data records (files) should by clearly identified (indexed). An identification of data files should indicate the type of data and its storage location. The creation of specific rules for data identification within each Research Group or Core Facility is highly recommended. The list of existing data files must also be backed up regularly.

Data storage on a long-term basis can be complicated, especially if they represent a part of extensive studies or are created within a cutting-edge infrastructure that is able to provide good quality data in a large amount. Therefore, sufficient care should be taken to index the metadata files, which will allow for the easy retrieval of data files worldwide, and the meaningful re-use of the acquired data in further studies.

TIP: Prior to beginning the research project, it is necessary to consider which data will be generated and stored, and how they will be stored when preparing the so called Data Management Plan. It is possible to get support from the Institute of Computer Science at Masaryk University (info@ics.muni.cz) for the preparation of such plans.

2.5.1. Electronic Data Obtained from Contractual Research

For the data that have been obtained in connection with contractual research or as part of the services provided to external entities by the Core Facilities, the property rights, as well as their management, storage, and disclosure, are specified in the terms of the contract. Typically, their owner is not Masaryk University, but the research sponsor. Unless otherwise agreed, the Research Group Leader or Head of Core Facility shall be responsible for the management and protection of the data until the complete transfer of the data to the research sponsor.

TIP: In the case of any specific issues regarding contractual research, please contact the CEITEC MU Business Development Manager (daniela.trsova@ceitec.muni.cz).

2.5.2. Research Data Involving Human Entities

Although clinical, preclinical, and translational research are not typically conducted within CEITEC MU, human entities are often included in the study of basic biomedical research, and therefore this research subject to a strict handling of records and data from the implemented project. This type of record must then be processed and stored in a way that maximally protects the privacy and personal information of the subjects examined. It is recommended to completely anonymise the records (i.e., to remove all personal identification data and, only in justified cases, re-identification using unique codes). The key for the records and re-identification must be kept separately and in case of electronic records protected by a good quality system against possible publication.

The draft project, involving human entities, approved by the MUNI Research Ethics Committee must include the manner of handling the records and the data.

TIP: In the case of any specific questions related to research involving human entities, please contact the CEITEC MU Lawyer (jana.vozenilkova@ceitec.muni.cz).