

Documenting an Electrical Cell Stimulation Experiment– Guidelines at Work

ELAINE 2020 Conference

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```
// Lrp6 diffusion into lipid rafts
Membrane[LR[s?]:l + Lrp6(phos, bind):r + s_m?] -> Membrane[LR[Lrp6(phos, bind) + s?] + s_m?] @ ra_lrp*kRin*(4*3.14*radius)*(#r/(am-(3.14*radius*radius)));

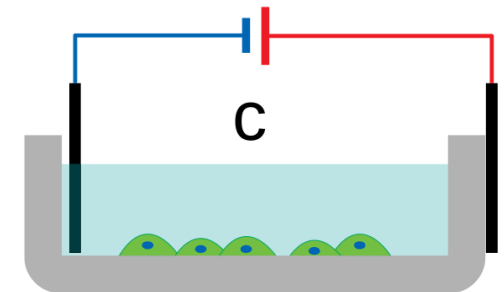
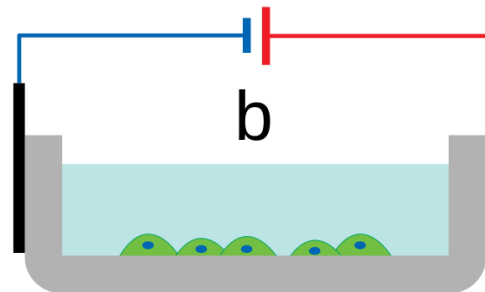
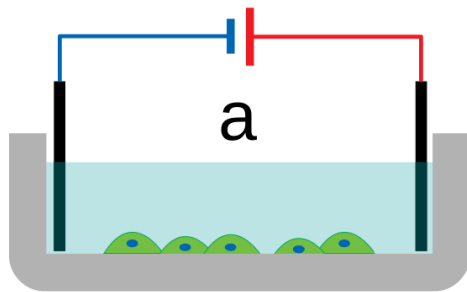
// CK1y diffusion into lipid rafts
Membrane[LR[s?]:l + CK1y:r + s_m?] -> Membrane[LR[CK1y + s?] + s_m?] @ kRin*(4*3.14*d*radius)*(#r/(am-(3.14*radius*radius)));

// Binding of Wnt to Lrp6 (representing Fz,Lrp6 receptor complex)
Wnt:w + Cell[Membrane[Lrp6('uP', 'uB'):l + sm?:] + s?] -> Cell[Membrane[Lrp6('uP', 'B') + sm?:] + s?] @ kWntBind*#w*#l;

// Beta-catenin shuttling into the nucleus
Bcat:b + Nuc[s?] -> Nuc[Bcat + s?] @ kbetain*#b;
```

In vitro electrical stimulation

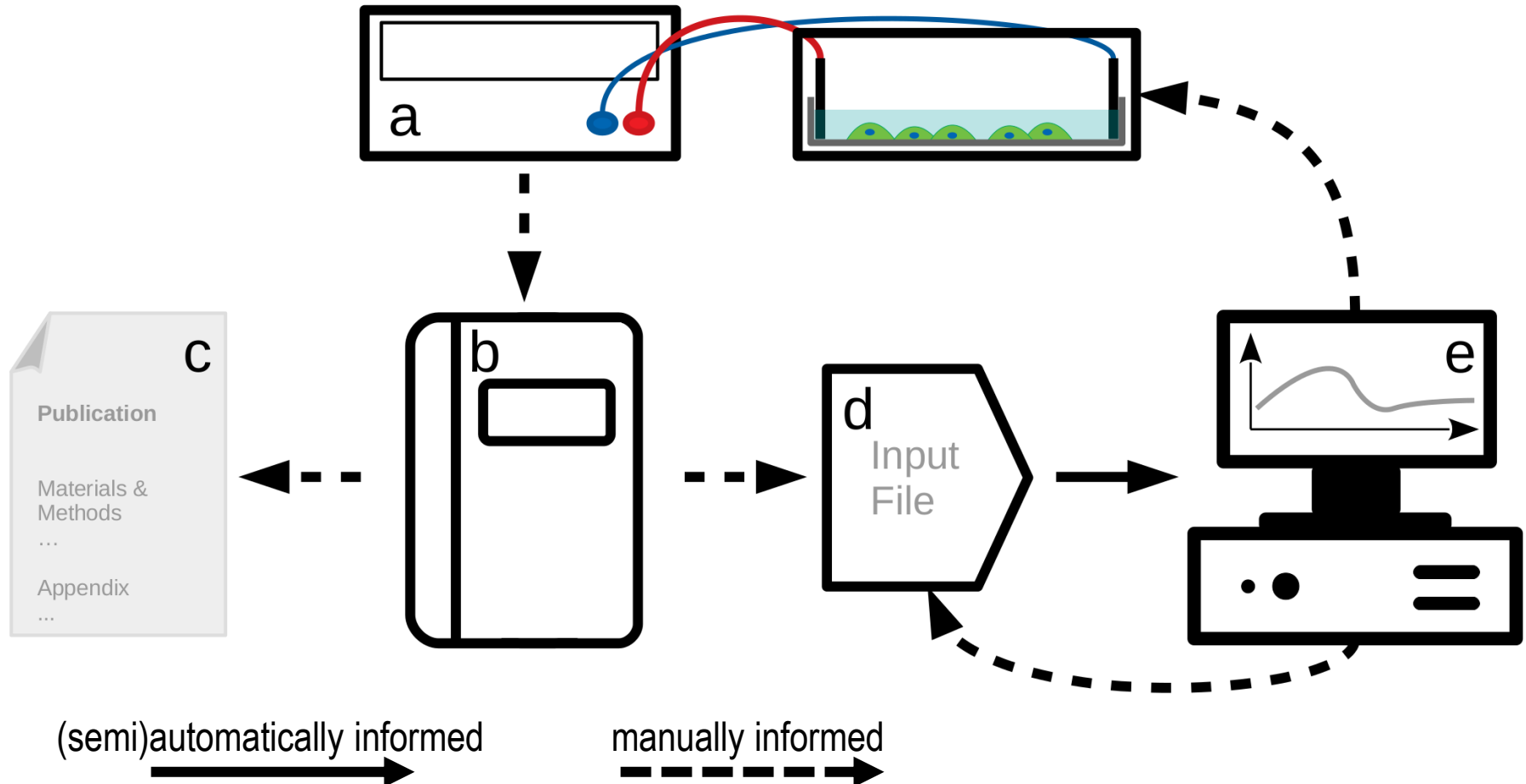
- Electrical stimulation with **direct** contact (a), **(semi-)capacitive coupling** (c / b)
- Alternative: Differentiate between **faradaic** and **non-faradaic** stimulation depending on whether electrons are transferred between the electrode and electrolyte.



- ❖ Electric field strength (E) usually reported, but not measured.
- ❖ Electrical input variables such as current (I) or voltage (U) not reported.
- Main issues regarding the **replicability** of published electrical stimulation experiments, for generating **input for computer simulations** and for **understanding the effects** of electric fields on cellular mechanisms.

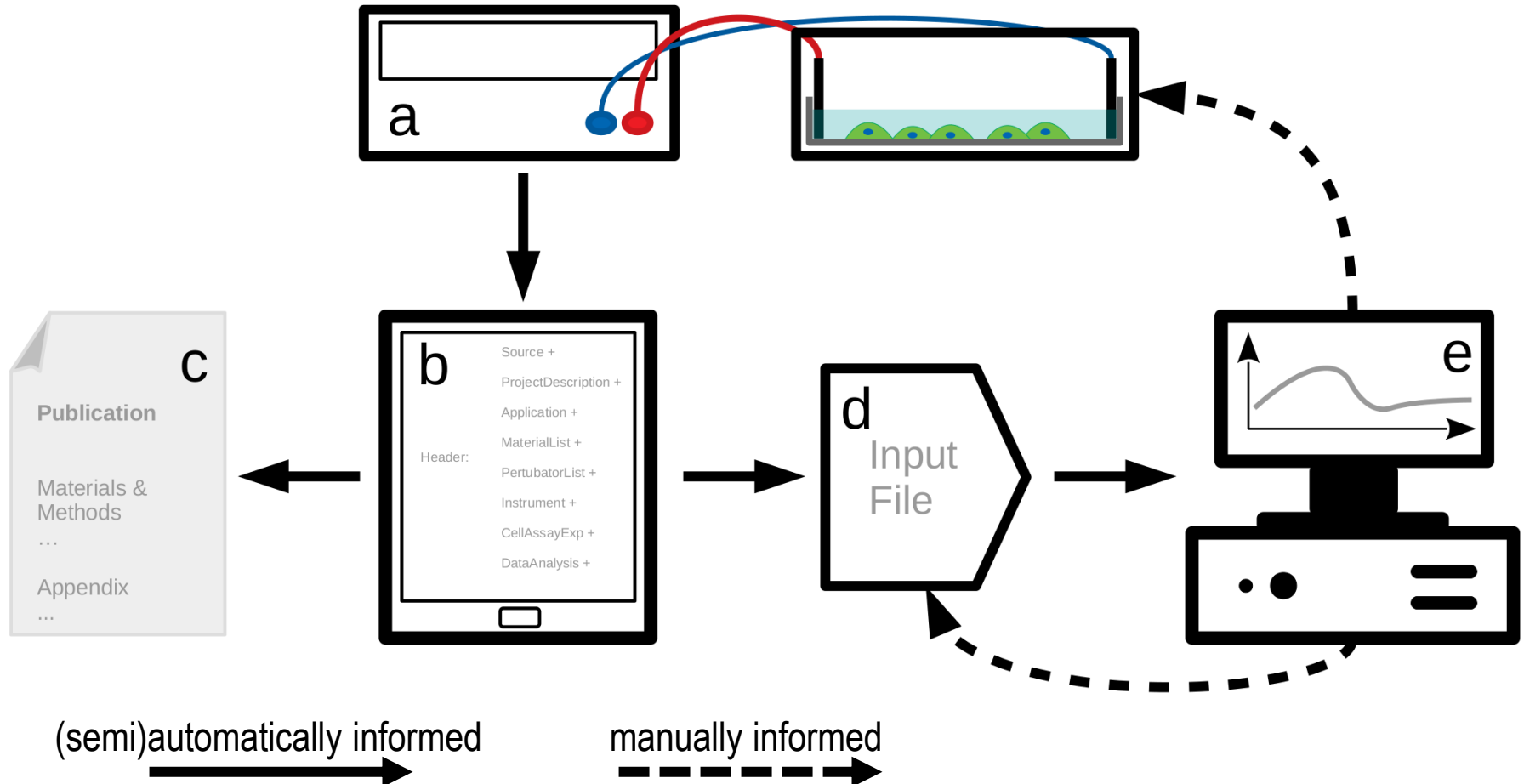
Documentation standard for repeatability of experiments and usability of data

What we have:



Documentation standard for repeatability of experiments and usability of data

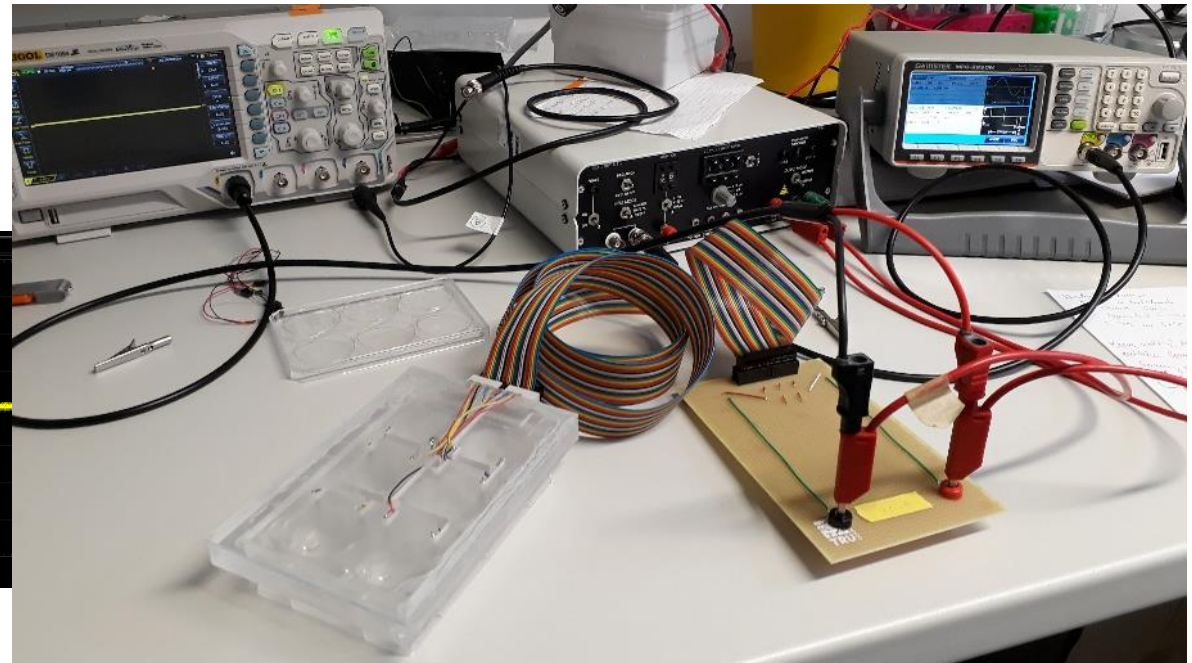
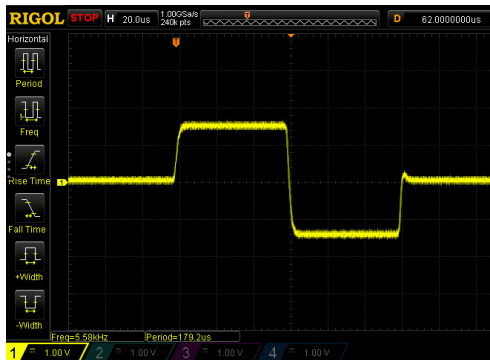
What we want:



- Adaptation of the **Minimum Information about a Cellular Assay (MIACA)** guideline:
 - Extended with
 - Contributors;
 - Reagent's use concentration as well as the reagent's storage and use temperatures;
 - Electrical Component (electric appliances are included in Instrument part)
 - Electrical Stimulation Device;
 - Pre-Treatment (PreTR) section.
 - Added “Steps” to “Pre-Treatment”, “Treatment”, and “Post-Treatment” sections
- **Template for documenting electrical cell stimulation experiments**
- Published at EMBC Conference and refined since then
[Budde, K., Zimmermann, J. et al. "[Requirements for Documenting Electrical Cell Stimulation Experiments for Replicability and Numerical Modeling](#)." 41st Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC). IEEE, 2019.]
- Application of our template for electronic lab notebooks ([elabFTW](#)) for an *in-vitro* experiment of electrically stimulating mouse neural stem cells

Our experimental set-up

- Electrical Stimulation Parameters:
 - Biphasic rectangle pulses (AC) with an amplitude of 1.5 V (voltage-driven)
 - Frequency of 130 Hz, 60 μ s (for each „plus“ and „minus“ pulse)
 - 3x24h parallel stimulation of six wells



Guideline at work

- Experiment: [3x24h AC Parallel Stimulation Nr. 3](#) → 30+ pages

The screenshot shows the eLabFTW interface. At the top, there is a navigation bar with 'EXPERIMENTS' highlighted. Below it, the title 'Experiments' is displayed, followed by a 'Back to listing' link. A light blue banner indicates the experiment is 'Owned by Elisa Neuhaus'. The experiment details include the date '2020.09.15', status 'Running', visibility 'Public', and authors 'Elisa Neuhaus, Kai Budde, Nils Arbeiter'. A series of tags describe the experiment: '130Hz', '3x24h', '1.5V', 'parallel stimulation', 'biophasic pulses', '60us', and 'voltage-driven'. The main title is '3x24h AC Parallel Stimulation Nr. 3'. Below the title, there is a 'Version: 20200924' and a 'Preface' section containing text about the ELN template and documentation requirements. The word 'Header' is visible at the bottom of the content area.

Reagent

(MULTIPLE) (Reagents are media, media supplements, kits, buffers and solutions, water,...)

- Reagent Name: Neurobasal-A-Medium
- Reagent ID: NeurobasalAMedium
- Reagent Vendor or Manufacturer: Gibco
- Reagent Order Number: [10888022](#)
- Reagent Lot Number: 2162332
- Reagent Stock Concentration: 1x
- **Reagent Usage Concentration:**
- Reagent Storage Temperature: 4°C
- Reagent Usage Temperature: 37°C

Guideline at work

Database

[Back to listing](#)

[Create](#)

2020.09.27

Team Elisa Neuhaus, Kai Budde, Nils Arbeiter



Reagent NeurobasalAMedium

Reagent Name:	Neurobasal-A-Medium
Reagent Manufacturer:	Gibco
Reagent Order Number (with link to vendor's website):	10888022
Reagent Stock Concentration:	1x
Reagent Storage Temperature:	4°C

Related experiments

[3x24h AC Parallel Stimulation Nr. 3](#)

Last modified on 2020-09-28 11:32:16

Composite Reagents

(MULTIPLE) (Individual reagents are often combined to make a complete cell culture medium, a staining mix, or e.g. make up the final perturbator [DNA prep, complex formation, production of chip-array in case of cell array].)

- Composite Reagent Name: Expansions medium
- Composite Reagent ID: ExpansionsMedium
- Composite Reagent List *(references to single reagents used with individual:)*
 - Reagent ID: [Reagent] NeurobasalAMedium
 - Reagent Volume: 48 mL
 - Reagent Concentration: 1x

 - Reagent ID: [Reagent] EGF
 - Reagent Volume: 40 μ L
 - Reagent Concentration:

 - Reagent ID: [Reagent] FGF

Key results

- **Work in progress** (The more people work with the template and electronic lab notebooks, the more change requests will be made.)
- **The template should be sufficient but can never be exhaustive.** (There is no necessity to fill out every point, but there should be an incentive to fill out as many points as possible and even add some.)
- Effort is high in the beginning, but subsequent experiment descriptions (protocols) will be easy due to:
 - **Duplicating** and adapting existing experiments.
 - Using **database entries** (for Array Support Type, Cell Line, Electrical Component, Instrument, Reagent, Stimulation Device, Software) whenever possible.
- Electronic lab notebooks are **easy** to:
 - to handle (e.g., backups);
 - to share and compare with;
 - to parse for other tools.

Acknowledgments



Thank you for your attention and thanks to our colleagues involved!

We gratefully acknowledge the financial support
of the DFG (German Research Foundation).

