Michigan Software
History
Past Experience
Attempted Solutions

- ask around
- vendor documentation
- OpenWetWare
- protocol specific software
Attempted Solutions: Cambridge 2010

Ligation ratio calculator
This tool will aid you with calculations for ligation of biobricks

<table>
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<tr>
<th>Vol (μl)</th>
<th>Buffer</th>
<th>Enzyme</th>
<th>Backbone</th>
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<th>Water</th>
<th>Total</th>
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<td>6</td>
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Components

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<th>Molar Ratio</th>
<th>Conc (ng/μl)</th>
<th>Length (bp)</th>
<th>Max Vol (μl)</th>
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### Attempted Solutions

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<th>Backbone Backbone</th>
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<th>Backbone Mass Used</th>
<th>Insert 1 Size</th>
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- **red** = failed protocols
- **green** = success
- **yellow** = in progress
- **white** = abandoned
What to do?
Michigan Software 2014
On the reproducibility of science: unique identification of research resources in the biomedical literature

Nicole A. Vasilevsky, Matthew H. Brush, Holly Paddock, Laura Ponting, Shreejoy J. Tripathy, Gregory M. LaRocca, Melissa A. Haendel
Published September 5, 2013 in PeerJ
Reproducibility of Protocols


http://dx.doi.org/10.7717/peerj.148
Hypothesis: Irreproducibility Caused By

- Poorly Documented
- Requires validation for each
- Hard to find relevant entries
Outreach
Who we surveyed:

- Non-student scientist: 43%
- Graduate student researcher: 23%
- Undergraduate student: 10%
- Laboratory iGEM team: 13%
- Software iGEM team: 0%
- Software engineer/no wet lab work: 2%
- Corporation: 0%
- Other: 8%
How often do you have trouble replicating protocols?

- 33% up to 100% of the time the outcome differs
- 63% up to 50% of the time the outcome differs
- 3% less than 25% of the time the experiment outcome differs
- 0% My protocols always work perfectly every time
What causes a Protocol to fail?

- 67% Unclear/confusing direction language
- 40% Using different reagents than the protocol writer
- 22% User error
- 62% Missing steps from the protocol
- 40% Tools/calibration of instruments not specified in protocol
- 10% Other
What would you think of an established database?

- 93% Use the site to browse and download protocols?
- 67% Submit your lab's own protocols in detail?
- 67% Be willing to answer other scientist's questions about your protocol via comments?
- 57% Be interested in voting up/down protocols that worked or did not work for you?
- 43% Be interested in linking directly to specific reagents you use for your work?
- 32% Be interested in being able to purchase specific reagents for specific protocols?
- 38% Use the site to calculate specific ratios of reagents?
- 2% Other
The Solution
What is ProtoCat?

A crowdsourced registry and review system for wetlab protocols
Methods
How it Works

GitHub

Server

Michigan Team

Python

SQL

Scientist

Upload/Review Protocols

Scientist

Scientist
Implementation: Django

- Python library

- Simplifies calling between the web interface and database using models and templates
Results
Welcome to ProtoCat, the free online catalogue of laboratory protocols.
Simplifying laboratory procedures one protocol at a time.
Create Your Protocol!

Title: 

Description: 

Text:

Create Protocol!
ProtoCat

Protocol Catalogue

Mini-Prep
Ligation
Digest
PCR

University of Michigan iGEM Software 2014
Title: Mini-Prep

Publisher: Cristina

Description: Cristina's Secret Mini-Prep Protocol

Date Published: Nov. 1, 2014, 9:14 a.m.

Protocol Text:

1. Transfer bacterial cells to a micro centrifuge tube. Centrifuge for 1 minute at high speed. Discard supernatant.

2. Resuspend bacterial cells in 250ul buffer P1(kept at ~4°C)

3. Add 250ul Buffer P2 and mix by inverting 4-6 times

4. Add 350ul Buffer N3 and mix immediately by inverting 4-6 times

5. Centrifuge for 10 minutes

6. Transfer supernatant to spin column by decasting

7. Wash the spin column by adding 500uls of buffer PB and centrifuge for 1 minute. Discard flow-through.

8. Wash spin column by adding 750uls of buffer PE and centrifuge for 1 minute. Discard flow-through and centrifuge for an additional minute.
7. Wash the spin column by adding 500uL of buffer PB and centrifuge for 1 minute. Discard flow-through.

8. Wash spin column by adding 750uL of buffer PE and centrifuge for 1 minute. Discard flow-through and centrifuge for an additional minute to remove residual wash buffer.

9. To elute DNA, place spin column in a clean 1.5ml micro centrifuge tube.

10. Add 25uL of ultra pure water, let stand for 1 minute and centrifuge for 1 minute.

11. Repeat step 10 to have a total of 50uL DNA, eluting with 25uL twice instead of doing 50uL once will give higher concentrated DNA.

Post a comment
Title: Mini-Prep

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Future of ProtoCat

- Searching
- Rating
- Filters
- More sophisticated input
- User page
Future of ProtoCat

- Reagent calculator
- Protocol Timing
- Host on global server
- Database bulk download
Future of ProtoCat

- Vendor information
- In-app purchasing
- Foster protocol sharing community
Future of Michigan Software

- Increase survey sample size
- Follow up survey of beta test
- Recruit more talent
- Win iGEM!
Success
- New iGEM team
- Repository for lab procedures
- Integrated results from outreach
- Protocols links for registry
Thanks

We’d like to thank our sponsors:

- Bioinformatics Department
- Advanced Research Center
Thanks

We’d like to give a special thanks to:

Marc Ammerlaan
Jim Cavalcoli
Thanks for your time.
**What best describes your role in research?**

- Non-student scientist: 26 (43%)
- Graduate student researcher: 14 (23%)
- Undergraduate student: 6 (10%)
- Laboratory iGEM team: 8 (13%)
- Software iGEM team: 0 (0%)
- Software engineer/no wet lab work: 1 (2%)
- Corporation: 0 (0%)
- Other: 5 (8%)

**How many years of laboratory research experience do you have?**

- Less than 1 year: 6 (10%)
- 1-3 years: 14 (23%)
- 4+ years: 40 (67%)

**How often do you have trouble replicating new protocols you get from collaborators, the internet, publications or other lab members?**

- less than 25% of the time the experiment outcome differs: 20 (33%)
- up to 50% of the time the outcome differs: 38 (63%)
- up to 100% of the time the outcome differs: 2 (3%)
- My protocols always work perfectly every time: 0 (0%)
When troubleshooting difficulties you're having with a new protocol, what problems ultimately cause the most difficulty?

- Unclear/confusing direction language: 40 (67%)
- Using different reagents than the protocol writer (e.g., antibodies): 24 (40%)
- User error: 13 (22%)
- Missing steps from the protocol: 37 (62%)
- Tools/calibration of instruments not specified in protocol: 24 (40%)
- Other: 6 (10%)

What resources do you consult when dealing with a difficult protocol?

- The primary source of the protocol (PI, grad student, collaborator, paper author): 47 (78%)
- The internet—Google searches, etc: 46 (77%)
- Social media—Twitter, Facebook, etc: 1 (2%)
- Lab members/team members: 52 (87%)
- Companies for reagent questions: 17 (28%)
- Other: 2 (3%)
Have you ever contacted the Customer Service department of a scientific product company for help with protocols or reagents?

- Yes, and their solutions ultimately helped me: 27 (45%)
- Yes, and their advice was mostly unhelpful: 12 (20%)
- No: 21 (35%)

If there was a free, online repository of established protocols for a variety of scientific procedures, would you...

- Use the site to browse and download protocols?: 56 (93%)
- Submit your lab's own protocols in detail?: 40 (67%)
- Be willing to answer other scientists' questions about your protocol via comments?: 40 (67%)
- Be interested in voting up/down protocols that worked or did not work for you?: 34 (57%)
- Be interested in linking directly to specific reagents you use for your work?: 26 (43%)
- Be interested in being able to purchase specific reagents for specific protocols?: 19 (32%)
- Use the site to calculate specific ratios of reagents?: 23 (38%)
- Other: 1 (2%)