

Automating Biology Lab Protocols with the OT-2



Authors

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INTRODUCTION

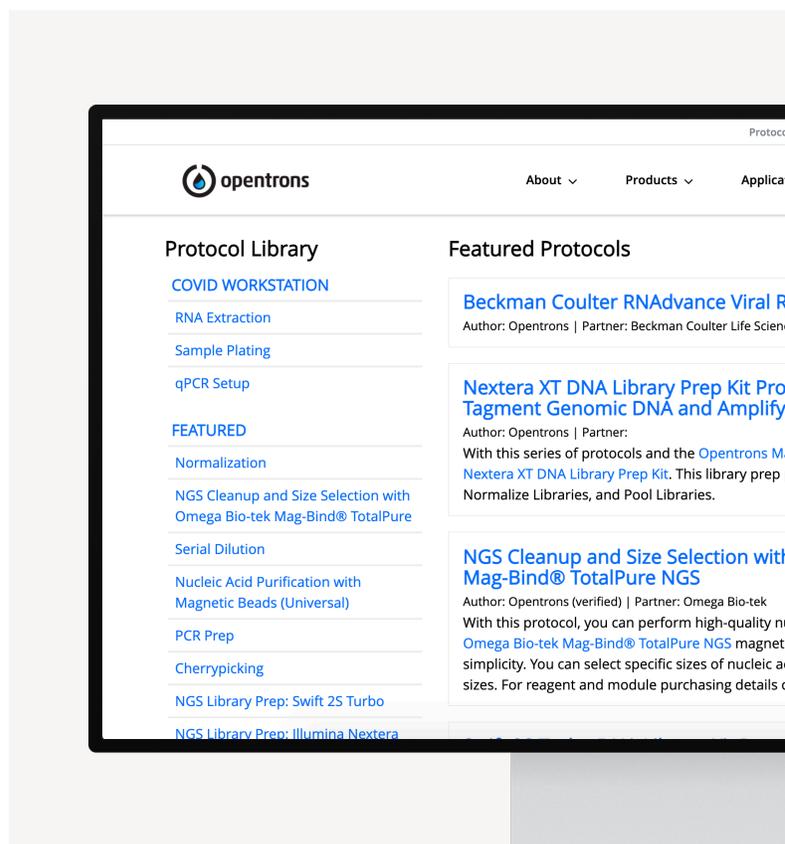
Automating biological laboratory protocols on the Opentrons' OT-2 robotic liquid handling platform is adaptable for various OT-2 workflows. The Opentrons' OT-2 Protocol Library provides users with open source and well-documented protocols, which are beginner-friendly and ready-to-use. This is typically the first option for users to gain experience performing protocols on the OT-2. We recognized that workflows vary, and further protocol optimization may be required. We offer enhanced options for optimizing workflows on the OT-2, including Protocol Designer, Python API, and Custom protocols. The Opentrons' Protocol Designer (PD) helps integrate modules and labware on the OT-2—without requiring the user to write code. For further protocol optimization, users can implement Opentrons' Python API for writing and automating code for biological protocols on the OT-2. Further assistance by the Opentrons' engineering team can develop a customized protocol for writing automative scripts for the OT-2. Here, we describe each of the Opentrons' API options and provide helpful resources to help navigate users to automate protocols on the OT-2.

THE OPENTRONS' PROTOCOL LIBRARY

Users can immediately access and download ready-to-use OT-2 protocols—without the user needing to write code. The protocol library contains hundreds of protocols developed by the Scientific team at Opentrons. Users can access, download, and run protocols from [Opentrons' Protocol Library here](#).

THE OPENTRONS' PROTOCOL DESIGNER

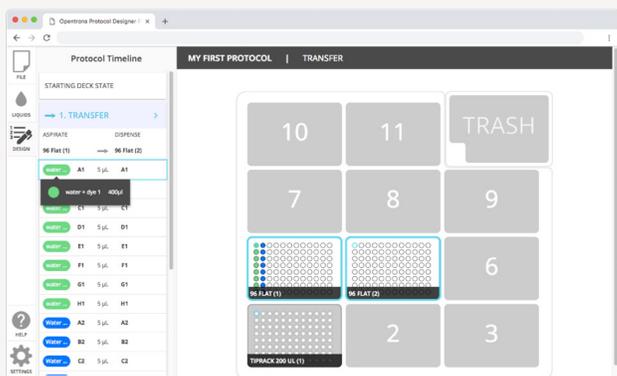
The Opentrons' Protocol Designer is a graphical interface that allows the users to optimize protocols that utilize existing scripts or import a CSV containing protocol



Screen displaying the Opentrons Protocol Library

specifications, which doesn't require the user to write code. The Opentrons' Protocol Designer is visual, intuitive and provides batch edit multiple steps for optimizing the OT-2 protocol, which includes liquid handling management, customized pipetting techniques, and integrates labware and modules. However, there are limitations in a user-defined variable and conditional logic, looping steps when automating the protocol, integrating higher liquid handling actions, and no integration with the Python program.

The user can customize an existing protocol without editing the code by selecting the available parameters using the drop-down menu. Upon choosing a protocol,



Screen displaying the Opentrons Protocol Designer

the user will have access to the protocol's readme file, which will contain information regarding the protocol, such as selecting the appropriate labware and pipette and the deck layout. The protocol's Python file can be downloaded and uploaded to Opentrons' robot with all selected parameters and immediately run the protocol. This offers a short learning curve for first-time users to automate OT-2 protocols; access to Opentrons' Protocol Designer can be found using [this link](#).

THE OPENTRONS' PYTHON API

Users with Python and wet lab experience can easily and quickly automate protocols using Opentrons' Python API, a simple Python framework designed to code automated biology laboratory protocols in a way that reads like a lab notebook. The Opentrons' Python API is open-source, well-documented, accessible, and supports the reproducibility of automated protocols. Users can get acquainted with our Python API by accessing, modifying, and running an existing Python protocol from our protocol library ([link](#)). Our protocol library contains various scientific protocols and applications using preparation kits performed on the OT-2 by the scientific team at Opentrons.

Opentrons' Python API can be used to automate various scientific workflows that include next-generation sequencing (NGS) preparations, nucleic acid extractions, serial dilutions, end-to-end polymerase chain reaction (PCR), cherrypicking, and concentration normalization.

With the Opentrons' Python API, the user can read and write to local files on the robot and retrieve log files after the protocol runs. For instance, users have access to files that can be useful for gaining insights, such as tracking pipet tips for minimizing tip waste during protocol runs. Moreover, the API integrates with the Opentrons' thermocycler for PCR experiments and integrates custom labware on the robot's deck, such as pipet tips, plates, and tube racks.

For users who desire to develop customized protocols using our Python API, our protocol structure contains five steps: metadata and version selection, run function, labware, pipettes, and commands. You can access further information about Opentrons' Python API and our Python API to write code for a customized protocol for the OT-2 can be found here: ([Python API link](#)).

OPENTRONS' CUSTOM PROTOCOL DEVELOPMENT

We have available service options for standard and expedited protocol development performed by the Opentrons' Applications and Engineering team.

For a low price of \$1,000, our team can develop a standard protocol for your workflow applications—under two weeks. Our team can create an expedited protocol—under one week for an additional \$300.

```

1 def get_values(*names):
2     import json
3     _all_values = json.loads("""{"pip_type":"p50_single","pip_mount":"right
4     return [_all_values[n] for n in names]
5
6
7 metadata = {
8     'protocolName': 'Illumina Nextera XT NGS Prep 2: Clean-Up Libraries',
9     'author': 'Opentrons <protocols@opentrons.com>',
10    'source': 'Protocol Library',
11    'apiLevel': '2.2'
12 }
13
14
15 def run(protocol):
16     [pip_type, pip_mount, no_of_samps, pcr_vol,
17     bead_ratio, dry_time] = get_values( # noqa: F821
18     'pip_type', 'pip_mount', 'no_of_samps', 'pcr_vol',
19     'bead_ratio', 'dry_time')
20
21     # labware setup
22     mag_deck = protocol.load_module('magdeck', '4')
23     mag_plate = mag_deck.load_labware('biorad_96_wellplate_200ul_pcr')
24     in_plate = protocol.load_labware(

```

Sample protocol

For a bulk service quote of a minimum of three customized protocols, we offer a discounted price of \$2,750—with a turnaround time of two weeks. Our team can perform an expedited protocol development—with a turnaround time of one week for an additional \$400.

Our team can work with your sales representative to set up a customized protocol development for your laboratory. To contact the Opentrons' Application Engineering team or submit a request for protocol development, please click here: [\(Custom Protocol link\)](#).

CONCLUSION

Here, we described an overview of how users can automate their biological protocols on the OT-2. Users have access to hundreds of well-documented and scientifically proven protocols optimized for the OT-2, which are available in our Protocol Library. In addition to this available tool, users have access to the Opentrons' Python API, which allows the user to write codes for automating protocols on the OT-2. Moreover, the user can develop a customized protocol by selecting available parameters using our Protocol Designer—without modifying the code. For further assistance, the Opentrons' Applications Engineering team can develop customized Python protocols using our Python API with a lead time of under two weeks for users who require additional support.