# Workflows Development Guide





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# Introduction

The Benchling Workflows process management application enables you to organize, optimize, and measure all your research and development workflows. It is a sequence of research processes and steps that are performed to answer research questions. You can develop and templatize workflows to connect the processes in your research pipeline.

With the Workflows application, you can drive efficiency across R&D processes by:

Increasing productivity across teams

Resolving bottlenecks to improve efficiency

Increasing visibility for process intelligence

# Workflows terminology

### Workflows

**Workflows** is a process management tool that integrates with lab automation and internal systems.

You can standardize your Organization's request fulfillment processes, manages assays or task requests, and connect processes in your research pipeline

### Task Schema

A **Task Schema** is a template where admins can configure the identity and behavior involved in a workflow.

### Flowchart

A **Flowchart** is a type of Task Schema that linearly groups other pre-existing Task Schemas together and allows the user to automatically map data between them

### **Execution Template**

An **Execution Template** is an entry template to be used in the fulfillment of a workflows. The Execution Template is defined per Workflow Schema and is only applicable to entry execution types.

### Task Group

A **Task Group** represents a set of jobs-to-do of the same type that were created together.

### Task

A **Task** represents the jobs-to-do in a workflow. Each task has standard operational properties - as well as the custom fields that represent the parameters required to do the job.

### Outputs

The **Outputs** of the workflow represent the result of completing a task. Each output links to one task from the workflow.

### Flowchart

A **Flowchart** is a type of Task Schema that linearly groups other pre-existing Task Schemas together and allows the user to automatically map data between them. **Routers** enable to define custom logic and control mappings for inputs and outputs between Tasks.

# Snapshot: How are workflows represented in Benchling?

#### Workflows manager

A view of the Workflows manager, where tasks can be searched using a variety of filters - tasks assigned to you, tasks of a certain status or type, etc.

<b>8</b>	Workflows / Search 🔻 🕸						
÷	Q Search	Type: Workflow Task	Group  Folder  Filters				
۹	< > 1-43 of 43 items 🞘						
+		Schema $\downarrow$	Name $\downarrow$	Task Status	Responsible team $\qquad \downarrow$		
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	😂 AD15	Analytical Request - Meta	Analytical Request - Metabolite 15	⊖o <mark>(©1</mark> ⊗o ⊗o ≜o ⊗o	Analytical		
	😂 DPD4	Antibody Purification	Antibody Purification 4	○0 ⓒ0 ⑳0 ╲0 ▲0 ♂3	Downstream PD		

# A view of a Cell Production task being created. In this view, you can find the configured fields and information that was filled out by the task creator.

Create task group: Cell Line Development						
Folde	r		١	Watchers		
		Entries		Benchling Support × Set watchers		
→) Ta	sks Cell Line Develo	pment 🕂			^	
	🚔 Assignee	Plasmid(s)*	# Number of Clones*	🛗 Need by Date*		
1	M Thomas McCror	y O TGEX- SCblue	4			
2	M Thomas McCror	y TGEX- O Scblue_ab1- LV_ab1-HV	5	12/13/2021		
3	Thomas McCror	y TGEX- ) Scblue_ab1- LV_ab2-HV	4			
≡				·		
G OI	tputs Cell Line Deve	lopment			^	
	Aa Cell Line					
1						
				Creat	e	

A view of a task execution template. Note the Task Name, Status, Sample, and Desired volume are pulled in from the task.

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+		*	Task		Status		Assignee	S	ample	Desired volume (mL)								
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		2	-0 ALQ1-T5		In Progress	~	Unassigned		s001	1	50							
8																		
		-J Cr	eate new contain	ers Tube	1 +								<	 ii -	🗔	Transfer		
8		R,	Source Entity	Destina	ition Location	Destina	tion Container	Quantity (u	uL) Conce	ntration (uM)								
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		=																

# A flowchart task group with four completed tasks and one failed task

TASK GR	OUP METADATA								FLOWCHART	
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-> T	asks 🥌 Cell line dev	relopment +		8.	₫ •		🖌 Edit	~	Transforming	ລ
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3	+D CLD1-T3	Completed	© CELL014		p003				● 4	
4	-D CLD1-T4	Completed	© CELL015		p004					
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4	C+ CLD1-04	-D CLD1-T3	1083	© TR c0	FX008- 01-p1					
5	G+ CLD1-05	-D CLD1-T3	<b></b> t084	© TR c0	FX008- 02-p1					
6	G+ CLD1-06	+D CLD1-T4	Ū 1086	© TR c0	FX009- 02-p1					

# Introduction to configuring Workflows

Configuration of tasks and task groups is currently done using a point-and-click interface.

Configure task groups from the Task Schemas page in Feature Settings.



The Task Schemas page lists all current task schemas. You can create a new task schema by clicking Create in the top-right corner.

- 👷	BIOPROCESS DEV REGISTRY SETTINGS					
	General	Task Schemas				
	Dropdowns	Q. Search Filtering by: Not archived V				
	Entity Schemas					
	Container Schemas	SCHEMAS				
	Box Schemas	Anabdical Donuest - FAC'S				
	Plate Schemas					
	Location Schemas	Analytical Request - Metabolite				
	Label Printing					
	LAB NOTEBOOK SETTINGS	Antibody Purification				
	Template Collections					
	ALITOMATION SCHEMAS	Assay - Biacore				
	Dup Schemas					
	Num annemaa	Bioanalytical Request - ELISA				
	RESULT SCHEMAS					
	Result Schemas	Bioanalytical Request - Sample Receipt				
	WORKFLOW SCHEMAS	Normal Rev.				
	Task Schemas	Bioreactor Run				
	TOOLS	Bioreactor Run - CAR1				
	Configuration Migration					
		Cell Line Development				
	DEVELOPER CONSOLE					
	Events	Formulation				
		Purity Testing				

# Task schema configuration

Task schemas define the type of assay or process step that will be tracked in the overall task group. Common task schemas include: Scientist A wants to perform an assay on a registered cell line

Scientist B wants the protein scientist team to purify a protein from a cell supernatant

This is the Create Task Schema modal, where you create the tasks and associated outputs of task groups. We will go through each of these sections in more detail.

Cre	ate Task Schema			
1	Task			
	Task group prefix*	Name*		Owner*
				Product Demo 🗸
	ID prefix*	Default responsible team		Execution type* 🔞
	T	Search for team		Entry v
	Status lifecycle* 🕜	Execution template*		Assignee
	Entry ~	Configure		Can set assignee on task creation
	Default task group folder	Default execution entry folder		Flowchart only
	Choose Folder	Choose Folder		Can only be used as part of a flowchart
	Task fields +	Required	Multi-select	Definition
	This schema does not have any task fields			
2	Output			
<u> </u>	ID prefix*			
	0			
	Output fields +	Required	Multi-select	Definition
	This schema does not have any output fields			
	Output $\rightarrow$ task lookup 😨 Configure the lookup after the task schema is created.			

### Task

Configure task properties and parameters that need to be completed. Required fields are indicated with a red asterisk. Task fields include:

### Default responsible team (optional)

Automatically assigns a team responsible for this work. The assigned group receives notifications for new tasks.

#### **Execution template**

Configure the entry template used to execute tasks. This can only be selected if the task is assigned the Entry execution type.

#### **Execution type**

Choose how your tasks are executed:

Entry: A scientist executes a task by creating a Notebook entry

Direct: A task marked as complete either directly or via the API

Flowchart: A scientist executes a series of ordered tasks, encompassing a complete process

#### Name

Descriptive name that displays in creation menus and search, and is used to generate names for task groups.

#### **Owner**

Controls which organization owns the schema and has the permissions to edit.

#### **Status lifecycle**

Determine when tasks are defined as complete. Status lifecycles for tasks are:

Entry

#### Entry review

**Direct Completion** 

Flowchart

#### **Task Group Prefix**

Short prefix used to generate sequential, unique IDs for task groups.

#### **Fieilds**

Similar to Registry fields, there are multiple types of fields that can be configured on a task. These fields can be required or multi-select, depending on the field type

#### **Snapshot Fields**

A configurable task/output field that pulls Registry, Inventory, or Results information from a specified pre-existing field. The snapshot field captures information when the task is created or the output is submitted and does not update, even if the original source is updated.

#### Assignee

Can set assignee on task creation

Flowchart only

Can only be used as part of a flowchart

If a task schema uses the Entry or Direct execution type, you can choose to enable additional functionality as shown in the image above. These include: Allowing for assigning tasks to users upon task creation

Restricting the task group used when assembling flowchart task schemas

Note: After a task schema is created, the Owner, Execution Type, and Status Lifecycle fields cannot be updated.

# View of the Task section of the Task Schema module, where you configure the Tasks properties and fields.

Task S Strai	ichemas / n Banking				Export *	
1	Task					
	Task group prefix*	Name*		Owner		
	BANK	Strain Banking		Product Demo		
1	ID prefix*	Default responsible team		Execution type 💿		
	т	Cell Banking		Entry		
	Task ID preview: BANK1-T1					
:	Status lifecycle 🔞	Execution template*		Assignee		
	Entry	🗊 🚖Strain Banking		Can set assignee on task creation		
	Default task group folder Choose Folder	Default execution entry folder Choose Folder		Flowchart only Can only be used as part of a flowchart		
	Task fields +	Required	Multi-select	Definition		
	Strain	√		Ö Strain		

# View of all supported task fields with one task field already configured.

				citary recvi	IC W			
0	Execution template*				 #	Search Text Number Date	> > >	
	Task prefix* T Task ID preview: PPI-T1				:= Ø	Dropdown Attachment	>	
	Task fields +	Required	Multi-select	Definitio		Entity	>	
	This is a field	0		An Text	fx vt	Computed field (snapshot)	-	× ./

### Output

Currently, every relationship between tasks and outputs needs to be configured with separate task group information. Required fields are indicated with a red asterisk. These fields include:

#### **Tasks Prefix**

Short prefix used to generate sequential, unique IDs for Outputs. The ID is structured as workflowID-Prefix#

#### **Fields**

Similar to Registry fields, there are multiple types of fields that can be configured on an output. These fields can be required or multiselect, depending on the field type. Common configurations are Registry entities or containers.

## View of all supported output fields with one output already configured for a plasmid prep.

	Task fields $+$	Required	Multi-select	Definitio Search
	This is a field			Aa Text >
	Insert a field			Aa Te # Number > × ✓
				iii Date >
	Output			🗉 Dropdown >
3				Attachment
	Output prefix*			Entry
	O Output ID preview: PPI-O1			Entity >
				Inventory >
	Output fields +	Required	Multi-select	Definitio
	Plasmid Prep			📱 Plasmid Prep 🦂 🗙 🗸

### Output - Task Lookup

Based on Registry and Inventory lineage, you can automatically associate each output with a corresponding task field in the execution entry.

From the Plasmid Prep designated as the output of the task, we are looking up the gene expressed via a lookup configuration

Configure lookup	$\times$
1 Specify lookup object 2 Specify lookup attribute	
✓ Lookup step	
Start from	
Plasmid Prep (Plasmid Prep) ~	
Linked item	
$\Leftrightarrow$ Gene (GENE)	
Plasmid Prep (Plasmid Prep)	
Plasmid Sequence	
Backbone	
✓ Gene	
⇒ DNA Part list	
+ Add lookup step	
Continue	

The gene is associated with the Gene in Plasmid Prep task field



### **Execution template**

When you select Entry as the task schema's execution type, you will need to configure a paired notebook entry template. This template will always be used to execute tasks for this workflow schema.

To create the initial template, click **Configure** on the task schema. Name your template and store it in an existing template collection. You cannot edit the contents of the entry template until the schema is created. Edit templates by clicking the entry name on the task schema or via Template Collections. The name of the template will appear read-only until after the schema is created. Add registration, transfer, and results tables and other useful content to the entry template to support your use case. You can add content above, below, or between tasks and output tables.

You cannot remove the tasks and outputs tables from the notebook entry template or configure default values or formulas.

# **Configuring a Flowchart**

Flowcharts orchestrate workflows that span multiple steps and/or multiple users to improve collaboration and execution efficiency.

Flowchart schemas group task groups together to accurately map complex multi-step processes. Flowchart schemas may be configured to seamlessly map data through linear, branching, or merging pathways.

To configure a flowchart, you will:

- 1 Create the flowchart task schema.
- 2 Add steps to the flowchart.
- 3 Configure transitions between flowchart tasks.
- 4 Design a path for the flowchart to follow or allow the user to define it themselves.

#### Create a flowchart task schema

To create a flowchart task schema:

1 Click your initials in the bottom-left corner to access your settings.

2 In the menu, hover over **Feature Settings** and select **Workflow Schemas.** 

- 3 On the **Task Schemas** page, click **Create**.
- 4 Complete the Task section:
  - Fill in general task metadata such as title, prefix, and default responsible team.
  - Select Flowchart from the Execution Type dropdown menu.
  - Fill in the Task Fields table with the data required to begin the flowchart workflow.
     For example, an initial sample to process, a due date, or additional parameters related to your use case.
- 5 Complete the Output section by populating the Output Fields table with data to be produced by the flowchart workflow. For example, a final product, quality control metrics, or other output data.

6 Click Create.

#### Add tasks to the flowchart

After creating the flowchart task schema, complete the flowchart section by first configuring the flowchart's steps. This section is unique to flowcharts and inserts other task schemas as steps between the flowchart's Task and Output.

To add steps to the flowchart:

- 1 Click **Edit** on the flowchart configuration table under the Flowchart section of the schema configuration page. Select the Task Schemas sub-tab.
- 2 Click +Add Task Schema to add new tasks to the flowchart.
- 3 Select the applicable task schema(s) from the drop-down menu.
- 4 Remove task schemas by clicking the trash can icon on the right-hand side.

Note: the order of the task schemas on this tab has no bearing on how the flowchart will be executed. You will define flowchart's path and data mapping properties in the next two steps.

3	Flowchart		
	Flowchart configuration	Cancel	Submit
	TASK SCHEMAS TRANSITIONS TEMPLATE FLOWCHART		
	+ Add task schema		
	Mycoplasma Testing (direct)		
	n'hoebreene roomië (enrod)		

#### Configure transitions between flowchart tasks

After configuring the flowchart steps, you need to configure how data is passed from one step to the next. Transitions allow users to move smoothly through flowcharts by connecting or mapping data between task schemas, and will automatically launch the next task when the previous one is completed. You may create transitions between any combination of task schemas selected for your flowchart in the prior step, as long as the data being mapped from the source properly aligns to the destination. Transitions determine the total number of viable paths your flowchart may take.

To add steps to the flowchart:

- 1 Click **+Add Transition** on the Transitions sub-tab of the flowchart configuration table.
- 2 Select the source task schema(s) from the first drop-down menu.
  - Note: It is possible to map data from multiple source task schemas to the same destination task schema. You will be prompted to choose the source schema for each mapped field in the mapping window.Task table, by selecting Flowchart task as the lookup object.
- 3 Select the target task schema from the second drop-down menu.
- 4 Click **Configure** to configure the data mapping between your source and target task schemas.
- 5 Choose whether to map data from either the source schema's Output or Task table using the first dropdown menu. If you're mapping from multiple source schemas, make this decision for each source schema.
- 6 Click **Configure Mapping** next to each field on the destination task schema. You may configure mapping for any field on the destination task schema. You may choose not to map to certain fields, but at least one field must be mapped to save the flowchart configuration.

Source schema Map from   Cell Line Task Output   Map to fields in Cell Line Generation / Mycoplasma / Viability [Flowchart] From fields in Cell Line Task   Map to Map from   I Cryovial Configure mapping   I Cell Line Tested Configure mapping   I Viability Pass/Fail Configure mapping		
Source schema Map from   Cell Line Task Output   Map to   Map to Map from   I Cryovial Configure mapping   I Cll Line Tested Configure mapping   Mycoplasma Pass/Fail Configure mapping		
Cell Line Task Output   Output   Wap to fields in Cell Line Generation / Mycoplasma / Viability [Flowchart] from fields in Cell Line Task   Map to Map from   I Cryovial Configure mapping   I Cll Line Tested Configure mapping   I Mycoplasma Pass/Fail Configure mapping	Map from	
Map to fields in Cell Line Generation / Mycoplasma / Viability [Flowchart] from fields in Cell Line Task         Map to       Map from         I       Cryovial       Configure mapping         I       Cell Line Tested       Configure mapping         I       Mycoplasma Pass/Fail       Configure mapping         I       Viability Pass/Fail       Configure mapping	Output	~
Image: Cryovial       Configure mapping         Image: Cell Line Tested       Configure mapping         Image: Amage: Configure mapping       Configure mapping         Image: Amage: Configure mapping       Configure mapping	Map from	
Image: Cryovial       Configure mapping         Image: Cell Line Tested       Configure mapping         Image: Amage: Configure mapping       Configure mapping         Image: Amage: Configure mapping       Configure mapping	Map from	
Cell Line Tested       Configure mapping         Mycoplasma Pass/Fail       Configure mapping         Viability Pass/Fail       Configure mapping	Configure mapping	
An     Mycoplasma Pass/Fail     Configure mapping       An     Viability Pass/Fail     Configure mapping	Configure mapping	
Aa Viability Pass/Fail Configure mapping	Configure mapping	
	Configure mapping	

- 7 In the **Configure lookup** modal, select a lookup object and attribute to source the mapped data from.
  - Generally, the lookup object is a field on the previous Task or Output table, and the attribute is the field value. You can also choose to map any value from the flowchart's Task table, by selecting **Flowchart task** as the lookup object.
  - For more on Benchling's lookup functionality, visit Lookup columns and tables.
- 8 When all fields are configured, click **Finish**.

9 Repeat this process for each transition you'd like to create.

#### **Configure a Template Flowchart**

You can optionally build a template flowchart, which will serve as the default path your data will traverse any time you execute the Flowchart Task Group. You will choose from the task schemas you added earlier and draw transitions between these schemas based on what you have configured in the *transitions* tab. You may also add routers to the template flowchart, which allow you to direct tasks to downstream task groups based on configurable logic.

1 Click the **Open flowchart editor** button on the Template Flowchart sub-tab.

Flowcha	t config	guration		Cancel Submit
TASK SCH	EMAS	TRANSITIONS	TEMPLATE FLOWCHART	
Op	en flow	chart editor		
Users	must o	define the flow	chart when tasks are created	

- 2 Click and drag **task schemas** from the right hand panel and arrange them in the order of your choice. Note that you can build branches and merges into your flowchart.
- 3 Click and drag **routers** (the diamond shaped box) from the right hand panel and position them between tasks in the flowchart. Refer to the "Configuring Flowchart Routers" section for more information on creating logic for the router to follow. Note that the flowchart will have errors until you have configured the associated rule.
- 4 Draw **arrows** between the flowchart task, your selected task schema boxes, and the flowchart output. You may only draw arrows between tasks that represent Transitions you have already configured. Attempting to draw an arrow between two task schemas without a Transition linking them will result in an error. If you have added a router to your template flowchart, draw arrows from the input task into the top of the router, and from the bottom of the router to all output tasks.



5 Check the "Users can modify the flowchart when tasks are created" option if you'd like to allow users to edit their flowcharts.

Checking the "Users can modify the flowchart when tasks are created" option will allow users to draw a custom flowchart when creating a new task group. This will not have any lasting effect on the underlying task schema. You may also leave the template flowchart blank. If the template flowchart is left blank or the above option is checked, users will be prompted to draw the flowchart when executing the task group. They will perform the same actions as shown below in the configuration modal, pulling from the task schemas and transitions defined during the schema creation process. If you set a template flowchart and do not check the option to allow modification, users will be forced to follow the template flowchart when executing their task group.

6 Click **Submit** to save the entire flowchart configuration table.

Your flowchart task schema is now complete!

#### **Configure a Flowchart Router**

Now that you've configured a complete flowchart, you may insert **Routers** to add logic to your flowchart's branch points. Once it is placed at a branch point, configure a given router to read a task's metadata and determine which branch it should be mapped to. Routers allow for the configuration of multiple paths within the same workflow and limit the end user's need to manually edit the template flowchart.

Follow these steps to add a router to your template flowchart:

- 1 Begin editing the template flowchart.
  - a. Navigate to the Flowchart section of the Task schema configuration page, click "Edit".
  - b. Select the "Template Flowchart" sub-tab.
  - c. Click the **pencil button** to edit the template flowchart.
- 2 Drag the diamond-shaped **router** object onto the template flowchart.

#### 3 Connect tasks to the router

- a. Draw an arrow from exactly one source node to the top of the router.
- b. Draw arrows from the bottom of the router to at least two destination nodes.

Configure template flowchart	×
Auto layout     Cell Line Generation and Myrreplasma Testing (Finanthari)	Router Task Schemas
d Cel Line Tesk 1	C. The schemes by more d. Cel Line Tesk Mocoplasma Teoling ( gl. Cel Growth Assoy
Section 2 - S	

- 4 Hover over the router and select the **"Configure"** button to define the router's logic.
- 5 **Set logic rules** for each destination node connected to the router. There must always be one node that accepts all other cases not covered by the configured logic.
  - a. Click "Lookup Value" and use Benchling's lookup functionality to select one of the input task's metadata fields to evaluate.
  - b. Click the "select operator" dropdown to set the logical operator.
  - c. Click the "select value" dropdown to choose the desired metadata value for that rule.
  - d. Click the "select next step" dropdown and choose one of the destination nodes in the flowchart.

Edit router	×
Input node: 👲 Cell Line Task 1	
Router 1	
Rule 1	
If I Assay Type ✔ is    Mycoplasma	
then go to Wycoplasma Testing (direct) 1	
All other cases	
Go to Cell Growth Assay 1	
Delete     Cancel	Save

- 6 Repeat this process for all other routes in the router.
- 7 Set the destination node in the section marked "All other cases".
- 8 Click Save.

The router will now map tasks to the destination nodes based on the logic you defined. If an input task does not meet any of the routing criteria, it will be mapped to the destination node set to handle "all other cases". Use routers to control the flow of information throughout your flowchart and make things easier for your users.

Your flowchart task schema is now complete!

# Initiate a workflow

Create a task group to represent your workflows. You can create task groups in the Workflows dashboard or in a structured table.

#### **Workflows application**

To create a task group from the Workflows dashboard:

- 1 Click the **Workflows** icon in the left-side menu.
- 2 Click + and select the schema to create the task group in.
- 3 Create tasks by completing the Tasks table.
  - Each row of the Tasks table corresponds to one task.
  - For each row, fill in the relevant task parameters and assignees, if applicable.
- 4 Click **Create** to create the task group and corresponding tasks.
- 5 Click **Metadata** to add users as Watchers. They will receive notifications regarding task group status changes.

#### **Structured table**

You can create task groups from these structured tables:

Plate Creation	Output Table	Registration
Task Table	Transfer	

#### To create a task group from a structured table:

- 1 Click the **Create workflow tasks** icon at the top of the table.
- 2 Select the desired task schema from the drop-down menu.

#### 3 Create tasks by completing the Tasks table.

- For each row, fill in the relevant task parameters and assignees, if applicable.
- If the structured table contains an entity or inventory item and the chosen task group contains at least one field which accepts this type of entity or inventory item, Benchling will automatically add the item to the first acceptable field.

# Execute and complete a task

After creating a task group, you can execute tasks in notebook entries or in the task group. How you complete a task depends on its execution type. If its associated task schema supports the:

#### **Entry execution type**

You need to execute the task and associate it with a new or existing notebook entry to complete it.

#### **Direct execution type**

You can manually update its status in the task group to complete it. Tasks using this execution type are not executed into entries.

#### Flowchart execution type

When executed, the first sequential step of the flowchart is initiated automatically.

#### **Execute a task**

- 1 In the Workflows application, click > in the top-right corner of the panel to expand the Workflows dashboard.
- 2 Select Pending tasks. If you are executing multiple tasks, they must be of the same task schema.
- 3 Click **Execute** in the top-right corner.

The selected tasks execute into a new entry from the notebook template configured in the task schema. To execute tasks via this entry:

1	Click <b>Execute</b> from the Workflows dashboard.
2	Enter the entry name.
3	Select the Project or Folder the entry will be associated with.
4	Click <b>Execute</b> to continue.

Note: For flowchart task groups, the first step of the flowchart opens automatically upon execution at the flowchart level.

the flowchart after initiation.

View of pending tasks in the second node of the flowchart after initiation.

#### **Complete a task**

After executing a task, a new entry will be created with the selected tasks present as rows in the Tasks table.

- 1 Complete the entry to fulfill the task.
- 2 When the task's deliverable is created, add the entity, container, value or plate intended as the output to the Outputs table.
- 3 Fill in the required Task column to specify the task related to this output. Each output may only link to one task.

If the task lookup was configured in the Workflow Schema, you can use the **Link Output to Task** button to automatically associate the tasks with their outputs.

- 4 Click **Submit** on the Outputs table to create outputs. You can modify values and re-submit if needed.
- 5 The method to indicate the status is complete depends on the status lifecycle specified in the task schema:
  - Entry: Manually update the Status column in the entry's Tasks table or the task group to Completed.
  - Entry review: Send the entry for review. Once accepted, the status will automatically change to Completed.

#### Update a task

In the Tasks table at the top of your execution entry or in the task group, click the task's cell in the Status column and select a status from the drop-down menu. The available statuses will depend on the task's execution and lifecycle type and its current status.

Options include Planned, Invalid, In Progress, Failed, Cancelled, Completed, and may include Completed (after review).

# Workflows notifications

As tasks move through status changes and assigned users, Workflows sends automatic email notifications to relevant roles. This section explains:

Notification triggers and r	recipients
-----------------------------	------------

Customizing your notifications

#### Notification triggers and recipients

Use the table below to understand what events trigger notifications and which roles are notified. When you take an action, you will not receive a notification, even if you are in these roles.

Task group event	Assignee	Previous assignee	Responsible team	Watchers
The Assignee field is changed	✓	✓	N/A	~
A task is created	<ul> <li>Image: A set of the set of the</li></ul>	N/A	<ul> <li>Image: A set of the set of the</li></ul>	✓
A task is executed into an entry	✓	N/A	N/A	✓
Status is changed to: • Canceled • Completed • Failed • Invalid	~	N/A	N/A	~

Flowchart event	Responsible team	Watchers
A flowchart task is created	✓	✓
Flowchart status is changed to: • Canceled • Completed • Failed	N/A	~

#### **Customize notification recipients**

If you have Write permissions on a task group project, you can add watchers to ensure the right people are notified when important actions are taken.

To edit task group watchers:

- 1 In the workflow, click the Metadata tab.
- 2 Hover under the Watchers field and click the pencil icon.
- 3 Enter a user and select their name from the list. To remove a user, click the X next to their name.
- 4 Click the  $\checkmark$  to save.

Note: The task group creator is automatically set as a watcher.

The responsible team is assigned when the task group is created and cannot be updated. To learn more, visit Configure a Workflow Schema: Basic Information.

Tenchling	
2 tasks assigned to you were executed.	
View Tasks	
SEC 2	
Task ID	Updated By
SEC2-T5	Benchling Support
SEC2-T6	Benchling Support
- Team Benchling	

Example of an email notification received when two Tasks assigned to the receiver were Executed by Benchling Support

# Case studies

### **Analytical SEC**

Workflows supports a scientist requesting an analytical team perform an SEC on a protein sample.

#### **Task Schemas**

Configure the task schema for an Entry type execution.

Tasl	k Schemas / Analytical SEC (assay, entry, no review)		
1	Task		
	Task group prefix*	Name®	Owner
	SEC	Analytical SEC (assay, entr	wf-preview-trey
	ID prefix*	Default responsible team	Execution type
	т	Testers	Entry
	Task ID preview: SEC1-T1		
	Status lifecycle	Execution template*	
	Entry	III I ≥ SEC testing	

Add a task field for your timepoint sample and the date you need the results by. Optionally, add snapshot fields to pull relevant information such as Strain and AA Sequence from the timepoint sample.

Task fields +	Warehouse name	Required	Multi-select	Definition
Timepoint sample	timepoint_sample			I Timepoint sample
Date needed	date_needed			🛍 Date
Batch	batch		4	fr Imepoint sample (Timepoint → Batch (Fermentation Batch)
Strain	strain		¥	fx imepoint sample (Timepoint → Batch (Fermentation Batch) → Strain bank (Strain bank) → Strain (Strain)
AA sequence	aa_sequence			fx ☐ Timepoint sample (Timepoint → Batch (Fermentation Batch) → Strain bank (Strain bank) → Strain (Strain) → Protein (Protein) → $\rightleftharpoons$ Residues

#### **Output Table**

Add an output field for the analytical sample. Add snapshot fields that will pull results data filed to the sample in the execution entry into the output table.

2	Output Output prefix*				
	O Output ID preview: SEC1-O1				
	Output fields +	Warehouse name	Required	Multi-select	Definition
	Analytical sample	analytical_sample			Analytical sample
	Replicate temperature (C)	replicate_temperature_c			fs ☐ Analytical sample (Analytic → # Temp (C)
	Timepoint sample	timepoint_sample		~	fx ☐ Analytical sample (Analytic → ☐ Parent (Timepoint sample)
	Sulfite percent	sulfite_percent			fic ☐ Analytical sample (Analytic → ☐ SEC I Phosphates → # Percent
	Phosphate percent	phosphate_percent			fs I Analytical sample (Analytic → III SEC I Phosphates → # Percent

#### Task

Create a task lookup linking the analytical sample to its parent timepoint sample.



#### **Execution Template**

Create an execution template that begins with registering the analytical samples as children of the timepoint samples. Add results tables such as phosphates and sulfites.

Review task information									
→ Tasks Analytical SEC tasks 2 · ··· → Submit									
ĸ	⇒) Task	i≣ Status	🚢 Assignee	🛗 Schedu	ed on	Timepoint sample	🛗 Date i	needed	Batcl
1		OPending	O Unassigned						
Register replicate analytical samples									
<b>∷</b> Re	egister new entities Analyt	ical sample 1				÷ 5	≅ * \$	(#	Submit
ĸ	Entity	Parent	Aa Replicate #	# Temp (C)					
1	New Analytical sample								
≡									
Fecord phosphates									
⊞ R€	esults SEC   Phosphates 1					¢ "1	* ≟*		Submit
κ.	Analytical sample	# Area	# Amount	# Percent					
1			#VALUE!	#VALUE!					
≡									

#### **Completed Outputs**

The completed Outputs table will be filled with the linked tasks, analytical samples, and relevant results values.

G+ 01	Ge Outputs 1 Analytical SEC (assay, entry, no review)						
R.	C→ Output	→) Task*	Analytical sample	# Replicate temperature (C)	🗏 Timepoint sample	# Sulfite percent	# Phosphate percent
1	G→ SEC15-O2	→D SEC15-T2	B004-TP2REP-033	5	🗐 b004-TP2	0.00967	0.00967
2	G+ SEC15-04	+⊃ SEC15-T2	5004-TP2REP-034	10	🔳 b004-TP2	0.01934	0.01934
3	G+ SEC15-05	≁ SEC15-T3	B008-TP3REP-035	20	🗐 b008-TP3	0.02901	0.02901
4	G→ SEC15-O1	→D SEC15-T8	B004-TP2REP-033	5	🔳 b004-TP2	0.00967	0.00967
5	G+ SEC15-03	+ <b>∂</b> SEC15-T8	B004-TP2REP-034	10	b004-TP2	0.01934	0.01934

### **Strain Banking**

# Workflows supports confirming shipments.

#### **Task Schemas**

Configure the task schema for an Entry type execution.

⊺≀ S	Task Schemas / Strain banking						
Ċ	1) Task						
	Task group prefix*	Name*	Owner				
	BANK	Strain banking	wf-preview-trey				
	ID prefix*	Default responsible team	Execution type				
	т	None	Entry				
	Task ID preview: BANK1-T1						
	Status lifecycle	Execution template*					
	Entry	Strain banking					

# Add task fields for the strain, the number of containers and the date needed.

Strain strain	Strain
Number of containers number_of_containers	# Integer
Date needed date_needed	🗰 Date

#### **Output Table**

Add output fields for the container and snapshot fields for the strain bank and volume.

Output						
Output prefix*						
0						
Output ID preview: BANK1-01						
Output fields +	Warehouse name	Required	Multi-select	Definition		
Container	container			Tube		
Strain bank	strain_bank		4	$f^{x}$ Container (Tube) $\rightarrow$ Strain bank		
Volume (uL)	volume_ul			fix ☐ Container (Tube) → # Volume (uL)		

#### **Task Lookup**

Configure a task lookup to look at the container, the container's strain bank and the parent strain to link to a task.

$Output \to task \ lookup$	
$\boxed{1}$ Container (Tube) $\rightarrow$ $\boxed{1}$ Strain bank	$\rightarrow$
$\blacksquare$ Strain (Strain) $\rightarrow$ $\rightarrow$ Task	

#### **Execution Template**

Create an execution template that begins with registering the strain bank samples as children of the strain. Add a transfer table to create the container and store it in a location.

DAY 1								
<b>-</b> € Ta	→ Tasks Strain banking tasks				°⊒ ▼ == ▼	ə	ூ Submit	^
κ	→) Task	i≣ Status	Assignee		Strain	# Numb	ber of ainers	
1		OPending	O Unassigned					
🔆 Register new entities Strain bank 1 🕹 😂 👻 🖆 🗰 👯 Submit						Submit	^	
ĸ	Entity	Strain # Ba	ink imber					
1	New Strain bank							
≡								
→ J Create new containers Tube 1							~	
κ.	Source Entity*	Destination Location*	Destination Container	#	Quantity (uL)	# Conce	entration (uM)	
1	Choose an entity		(Autogenerated)					
=								-

#### **Completed Outputs**

The completed outputs table will be filled with linked tasks, the containers holding the strain banks, and the volume in those containers.

G→ 01	C+ Outputs Strain banking							
ĸ	⊖ Output	→) Task*	Container	Strain bank	# Volume (uL)			
1	C+ BANK6-O3	DBANK6-T1	<b></b> t044	S003-BANK1	50			
2	C→ BANK6-O1	Denking Bank6-T2	<b></b> t042	S004-BANK1	50			
3	C→ BANK6-O2	→ BANK6-T2	<b></b> t043	S004-BANK1	50			

### **Shipping Confirmation** Workflows supports confirming shipments.

#### **Task Schemas**

Configure the task schema for a direct execution type. Execution of these tasks will not require a notebook entry.

Task Schemas /

Shipping confirmation (direct, output)

1	Task				
	Task group prefix*	Name*	Owner		
	SHIP	Shipping confirmation (direct,	wf-preview-trey		
	ID prefix*	Default responsible team	Execution type		
	SHIP	Testers	Direct		
	Task ID preview: SHIP1-SHIP1				
	Status lifecycle	Execution template			
Direct Completion		Execution template is only available if execution type is entry.			

# Add task fields for vendor order number, date order placed, department, and a boolean dropdown for hazardous materials.

Task fields 🕂	Warehouse name	Required	Multi-select	Definition
Vendor order number	vendor_order_number			<u>Aa</u> Text
Date order placed	date_order_placed			Datetime
Department	department		1	≔ PLM - product area
Hazardous materials	hazardous_materials	~		i≣ Boolean

#### **Output Table**

Add outputs fields for the FedEx shipment number, expected delivery date, and receiving user.

2	Output			
0	Output prefix*			
	MANIFEST Output ID preview: SHIP1-MANI			
	Output fields +	Warehouse name	Required	Multi-select Definition
	FedEx number	fedex_number	~	Aa Text
	Expected delivery date	expected_delivery_dat		🗎 Datetime
	Receiving user	receiving_user		i≡ Plm - users

#### **Completed Outputs**

The completed outputs will contain the tasks and the output fields specified. This table will be filled out directly in the task group.

G+ 01	C> Outputs Shipping confirmation (direct, output)						
ĸ	⊖ Output	→) Task*	Aa FedEx number*	Expected delivery date	$\equiv$ Receiving user		
1	G→ SHIP5-MANIFEST1	<ul> <li>→ SHIP5-SHIP1</li> </ul>	D83G9KD	9/27/2021 10:42:16 AM -0500	Trey Miller		
2	G SHIP5-MANIFEST2	→ SHIP5-SHIP2	JK334KKD	9/29/2021 10:42:20 AM -0500	Trey Miller		
3	C→ SHIP5-MANIFEST3	→ SHIP5-SHIP3	JF30GGDK	9/28/2021 10:42:22 AM -0500	Isis Trechard		

### **Viral Vector Production Flowchart**

Workflows supports a multi-step viral vector production process. This flowchart links several task schemas together allowing the scientist to register component samples, generate vector lot containers, and record quality metrics.

#### Task Schema

Configure the task schema for a flowchart execution type.

1	Task			
	Task group prefix*	Name*		Owner
	OCTFF-VVRP-GROUPTEN	OctFF - Viral Vector Request Proc		Enablement - FY23 - Field Focus - Flowc
	ID prefix*	Execution type 📀		Status lifecycle 📀
	т	Flowchart		Flowchart
	Task ID preview: OCTFF-VVRP-GROUPTE			
	Execution template	Default task group folder		Default execution entry folder
	This setting is only available if execution type is Entry.	Group 10	Î	This setting is only available if execution type is Entry.
	Responsible team	Assignee		Flowchart only
	None	Flowchart tasks do not have assignees.		This setting is only available if execution type is Entry or Direct.

Add task fields for Plasmid, desired plasmid prep type, number of containers, Virus name, requested virus lot volume, and minimum titer required.

Task fields +	Warehouse name	Required	Multi-select	Definition
Plasmid	plasmid	~		Ö Plasmid
Plasmid Prep Type	plasmid_prep_type	√		≔ Plasmid Prep Type
Number of Containers	number_of_containers			# Integer
Virus Name	virus_name			Aa Text
Virus Lot Volume Requested (mL)	virus_lot_volume_requested_ ml			# Decimal
Minimum Titer (vg/mL)	minimum_titer_vgml			# Decimal

#### **Output Table**

Add output fields for the virus lot container, final titer, virus lot (automatically computed from the container), and endotoxin amount.

Output fields +	Warehouse name	Required	Multi-select	Definition
Virus Lot Container	virus_lot_container			⊟ Any inventory
Final Titer (vg/mL)	final_titer_vgml			# Decimal
Virus Lot	virus_lot			$f_{x}$ $\Box  \text{Virus Lot} \\ \text{Container}$ $\rightarrow \ \hline \forall \text{ Viral Vector}$ $\rightarrow \ \overline{\neg} \text{ Latest content}$
Endotoxin (EU/mL)	endotoxin_euml			# Decimal

#### **Flowchart**

Choose the task schemas that belong in the flowchart, create transitions between them, and design a template flowchart.

Flowchart configuration	🖌 Edit
TASK SCHEMAS TRANSITIONS TEMPLATE FLOWCHART	
OctFF - Viral Vector Production [DO NOT MODIFY]	
OctFF - Viral Titer Assay [DO NOT MODIFY]	
OctFF - Plasmid Prep Generation [DO NOT MODIFY]	
OctFF - Virus Registration [DO NOT MODIFY]	
OctFF - Endotoxin Assay [DO NOT MODIFY]	

#### List of Task Schemas in the Flowchart

Source schema	Mapping from
OctFF - Viral Vector Request Process - GROUP 10	Task 🗸
Mapping fields in OctFF - Virus Registration [DO NOT MODIFY] from field	s in OctFF - Viral Vector Request Process - GROUP 10
Mapping to	Mapping from
Aa Virus Name	Aa Virus Name
Reference Plasmid	C Plasmid (Plasmid)

Transition from Flowchart Task table  $\rightarrow$  Virus Registration Task

Source schema	Mapping from	
OctFF - Viral Vector Request Process - GROUP 10	Task	~
Mapping fields in OctFF - Plasmid Prep Generation [DO NOT MODIFY] from	fields in OctFF - Viral Vector Request Process - GROUP 10	
Mapping to	Mapping from	
Plasmid*	O Plasmid (Plasmid)	
Image: Plasmid Prep Type*	Plasmid Prep Type	
# Number of Containers	# Number of Containers	

Transition from Flowchart Task table  $\rightarrow$  Plasmid Prep Generation Task

Source schema	Mapping from	
OctFF - Virus Registration [DO NOT MODIFY]	Output	~
OctFF - Plasmid Prep Generation [DO NOT MODIFY]	Output	~
OctFF - Viral Vector Request Process - GROUP 10	Task	~

Mapping fields in OctFF - Viral Vector Production [DO NOT MODIFY] from fields in OctFF - Virus Registration [DO NOT MODIFY], OctFF - Plasmid Prep Generation [DO NOT MODIFY], OctFF - Viral Vector Request Process - GROUP 10

Mapping to	Source schema	Mapping from
Virus to Produce	OctFF - Virus Registration [DO NOT MODIFY]	Virus (Virus)
U Transgene Plasmid Prep Container	OctFF - Plasmid Prep Generation [DO NOT MODIFY]	✓ E Container
# Volume Requested (mL)	OctFF - Viral Vector Request Process - GROUP 10	Virus Lot + Volume Requested

Transition from Flowchart Task table, Virus Registration Task, and Plasmid Prep Generation Task  $\rightarrow$  Viral Vector Production Task

Source schema		Mapping from		
OctFF - Viral Vector Production [D0	D NOT MODIFY]	Output 🗸		
OctFF - Viral Vector Request Proce	ess - GROUP 10	Task 🗸		
Mapping fields in OctFF - Viral Titer Assay [DO NOT MODIFY] from fields in OctFF - Viral Vector Production [DO NOT MODIFY], OctFF - Viral Vector Request Process - GROUP 10				
Mapping to	Source schema	Mapping from		
U Container	OctFF - Viral Vector Production [DO NOT MODIFY]	∽ ⊟ Container		
# Minimum Titer (vg/mL)	OctFF - Viral Vector Request Process - GROUP 10	✓ ₩ Minimum Titer (vg/mL)		

Transition from Viral Vector Production Task  $\rightarrow$  Viral Titer Assay Task

/iew mapping			>
Mapping from source schema's task or output			
Source schema		Mapping from	
OctFF - Viral Vector Production [DO NOT MODIFY]		Output	~
flapping fields in OctFF - Endotoxin Assay [DO NOT	MODIFY] from fields in OctFF - Viral Vector Pro	oduction [DO NOT MODIFY]	
Mapping to	Mapping from		
0 Container	⊟ Container		

Transition from Viral Vector Production Task  $\rightarrow$  Endotoxin Assay Task

Source schema	Mapping from	
OctFF - Endotoxin Assay [DO NOT MODIFY]	Output	~
OctFF - Viral Titer Assay [DO NOT MODIFY]	Output	~

Mapping fields in OctFF - Viral Vector Request Process - GROUP 10 from fields in OctFF - Endotoxin Assay [DO NOT MODIFY], OctFF - Viral Titer Assay [DO NOT MODIFY]

Mapping to	Source schema		Mapping from
UVirus Lot Container	OctFF - Endotoxin Assay [DO NOT MODIFY]	*	Container
# Final Titer (vg/mL)	OctFF - Viral Titer Assay [DO NOT MODIFY]	~	# Final Titer (vg/mL)
# Endotoxin (EU/mL	OctFF - Endotoxin Assay [DO NOT MODIFY]	~	# Endotoxin (EU/mL)

Transition from Viral Titer Assay Task and Endotoxin Assay Task  $\rightarrow$  Flowchart Output table



Template Flowchart showing task organization