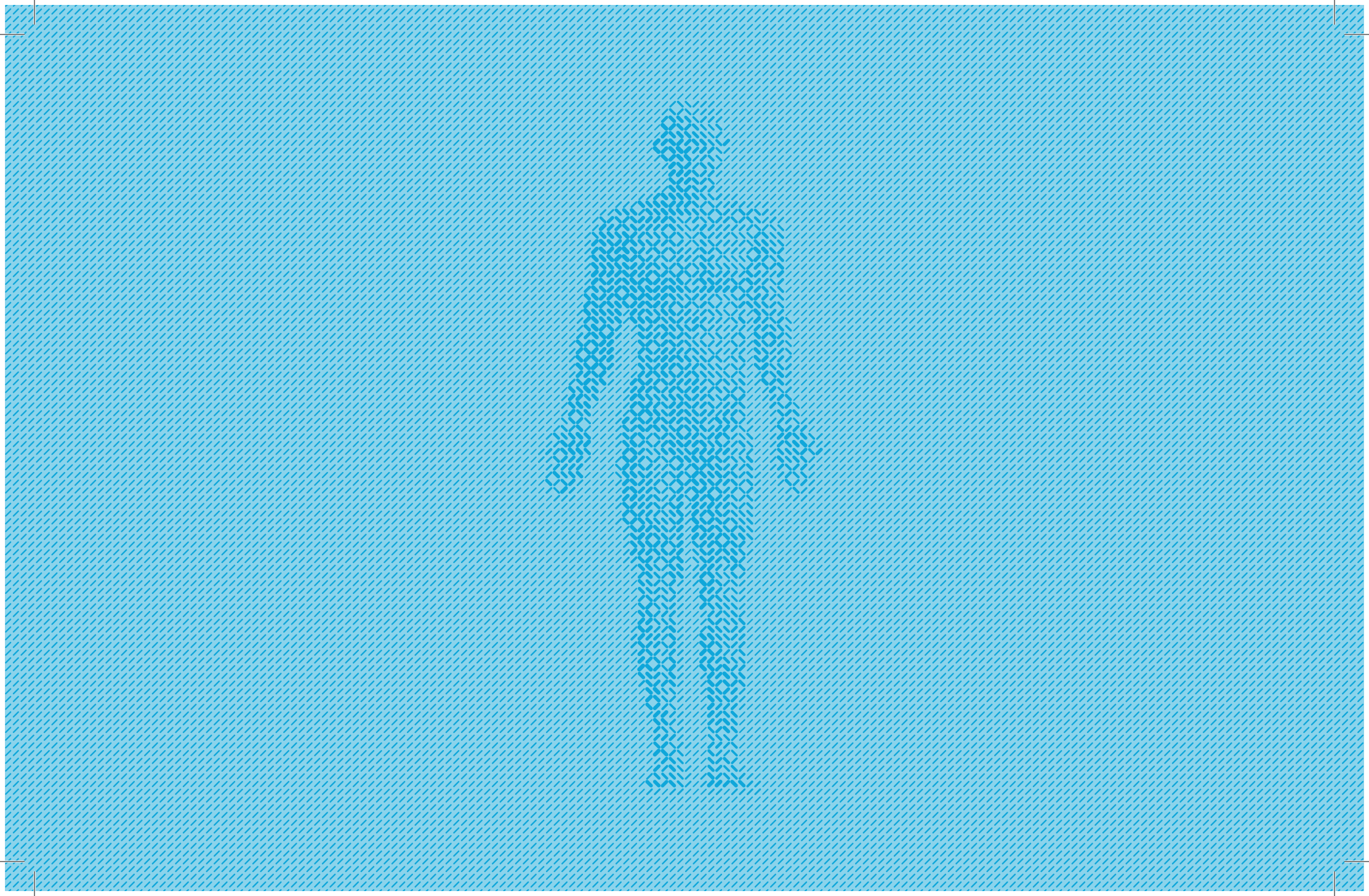
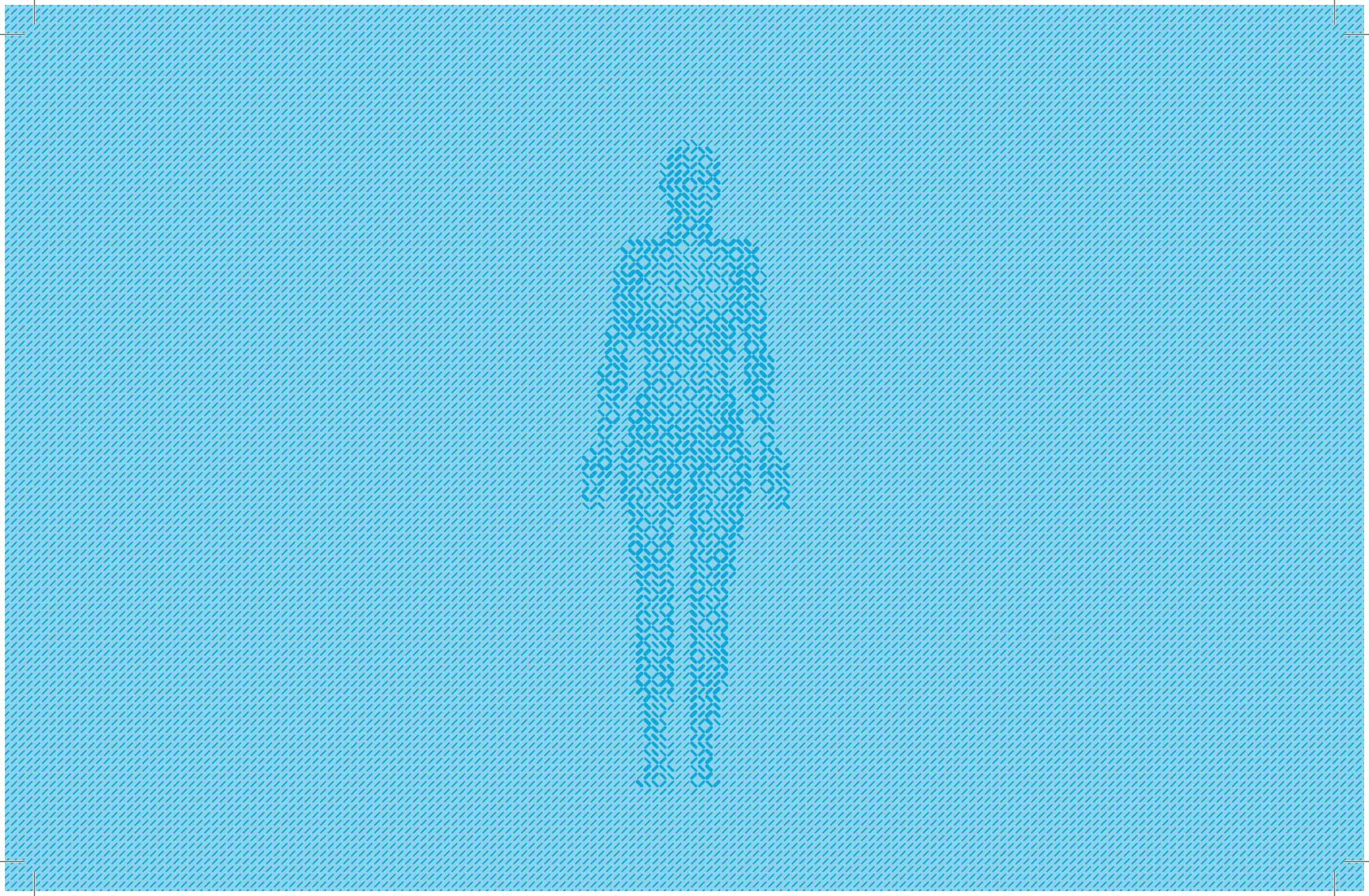
HUMAN
EMULATION
SYSTEM

ZOË-CM1™

culture module






emulate

Zoë™ Culture Module

Zoë means life.

Our Zoë Culture Module is designed to sustain the life of cells within our Organ-Chips.

The instrument automates the precise conditions needed for simultaneous cell culture of up to 12 Organ-Chips. It provides the dynamic flow of media and the mechanical forces – such as breathing motions, or peristalsis – that help our Organ-Chips recreate the microenvironment cells experience in the body.

The Culture Module gives users the ability to independently control the flow rate of media through the top and bottom channels of our Organ-Chips. It also allows users to determine stretch parameters – including frequency and amplitude – of the Organ-Chip membrane. What's more, the Zoë Culture Module has automated algorithms to prime the fluidic channels of Organ-Chips with media and programming to maintain the culture microenvironment for optimum cell performance.

Our work is directed towards a clear goal – to democratize Organs-on-Chips technology and create an easy-to-use research platform that emulates human biology for understanding how diseases, medicines, chemicals, and foods, affect human health.

This user guide contains important information to safely and effectively operate the Zoë-CM1™ instrument. Please ensure that all users thoroughly read and understand this guide before operation.

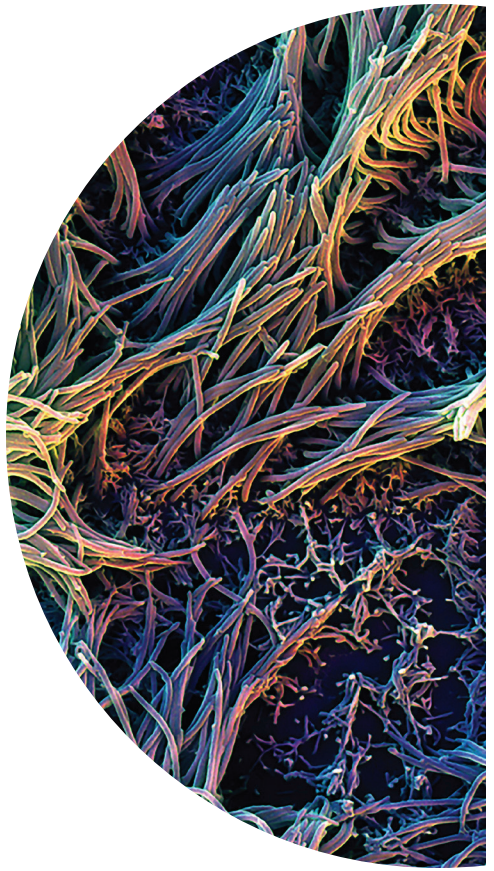
This product is for research use only.

User Guide

Table of Contents

Introduction

Use



1 Introduction

This section contains an overview of our Zoë™ Culture Module, the Organ-Chip, and the Pod™ assembly. Together these components recreate the microenvironment cells need to behave like they do within the body. The Zoë Culture Module can support up to 12 Organ-Chips simultaneously.

Zoë-CM1™

System Components

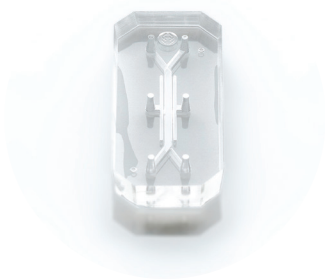
The Zoë™ Culture Module, the Organ-Chip, and the Pod™ assembly interact with each other to culture living cells. The Culture Module provides media flow from the Pod assembly to the Organ-Chip, and also provides the mechanical forces that emulate the physical movements of natural biological tissue. The Organ-Chip is a microenvironment in which cells live, while the Pod assembly contains the media needed to promote cell growth. The details of these components are described below.

Important note: this user guide covers the basic operation of The Zoë Culture Module. For specific protocols on using the Organ-Chips and the Pod assembly to culture cells, please refer to the appropriate documentation.

1

Zoë™ Culture Module

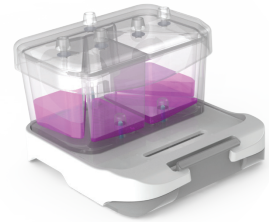
The Zoë Culture Module provides media flow, air, and vacuum to all installed Pod assemblies at flow rate and stretch parameters set by the user.



2

Organ-Chip

The Organ-Chip is a microenvironment for living cells that recreates human biology.



3

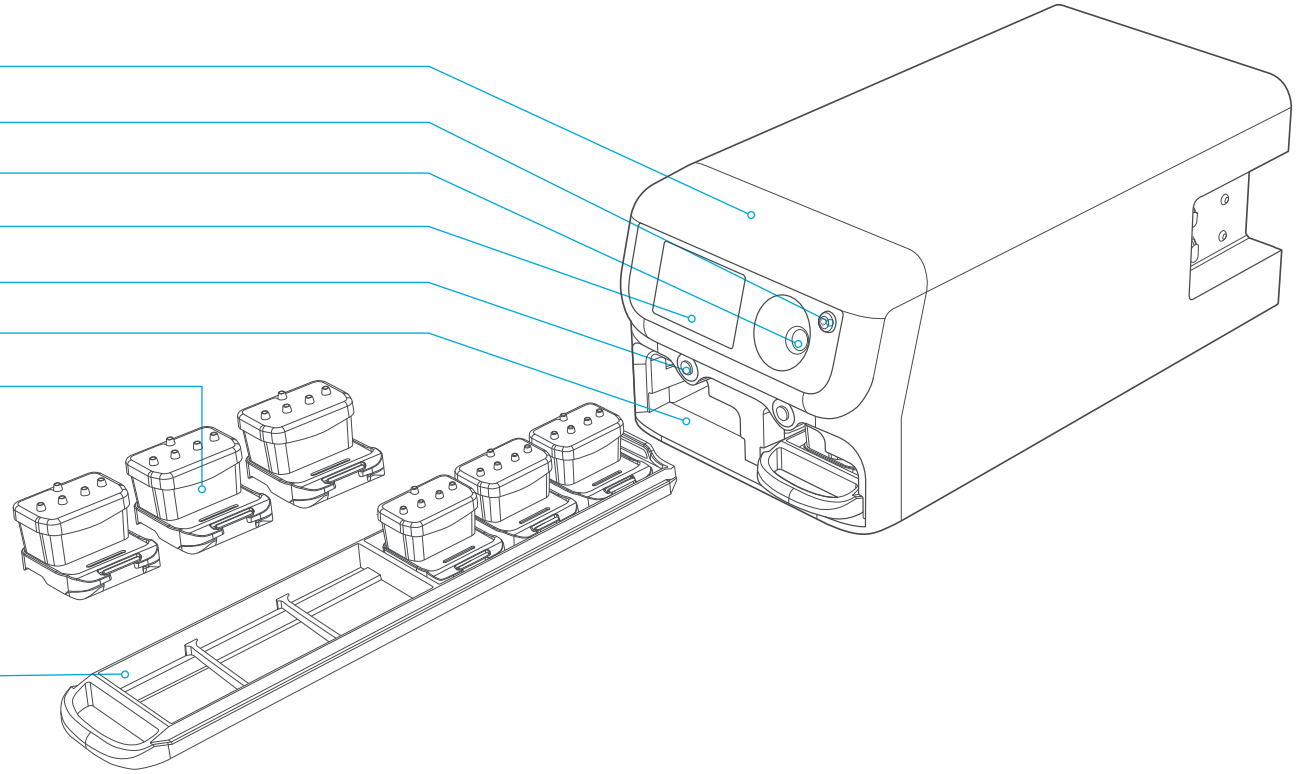
Pod™ Assembly

The Pod assembly contains and delivers cell media, air, and stretch to the Organ-Chip.

Zoë-CM1™

Components

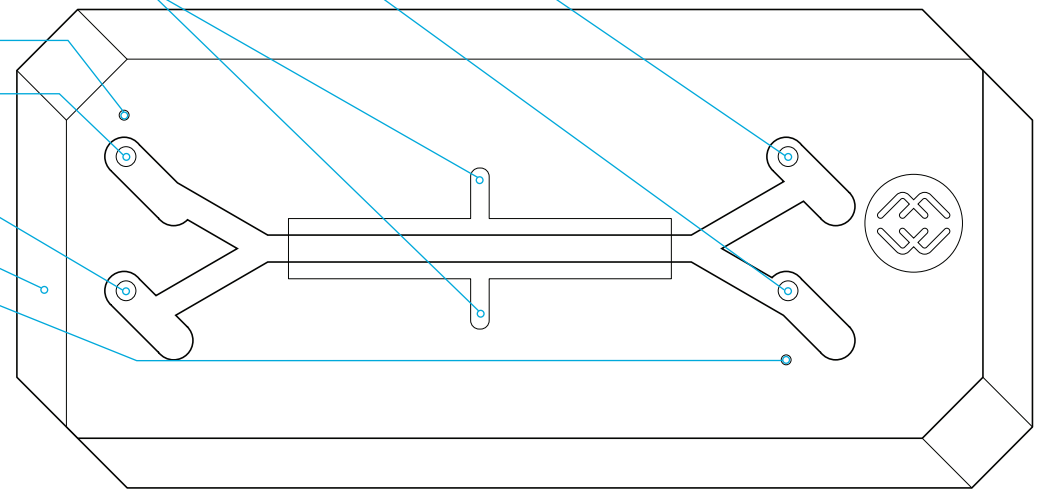
1. Zoë™ Culture Module
2. Power Button
3. Dial
4. Display
5. Activation Button
6. Bay
7. Pod™ Assembly
8. Tray



Organ-Chip

Configuration

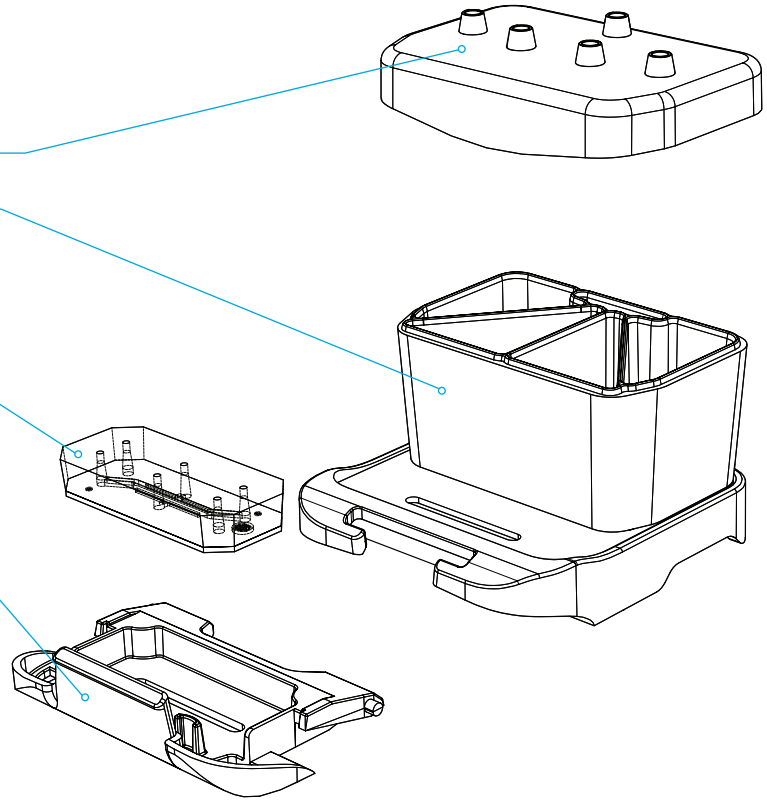
1. Bottom Channel Inlet Port
2. Top Channel Inlet Port
3. Vacuum Ports
4. Top Channel Indicator
5. Top Channel Outlet Port
6. Bottom Channel Outlet Port
7. Chip Body
8. Top Channel Indicator



Pod™

Components

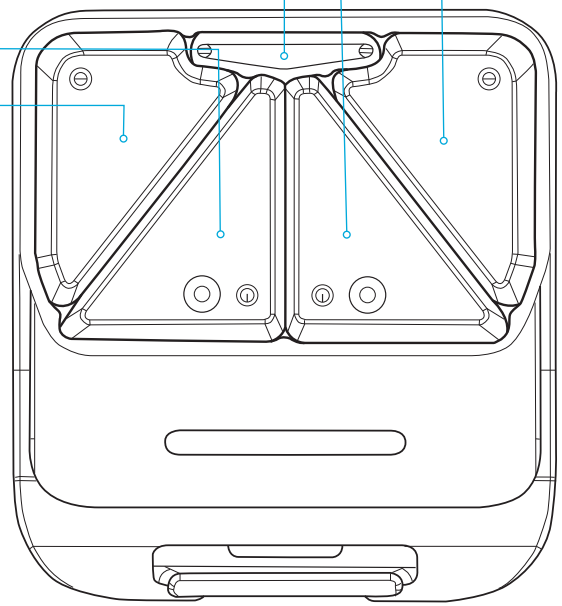
1. Pod Reservoir Lid
2. Pod Reservoir
3. Organ-Chip
4. Chip Carrier



Pod™ Reservoir

Configuration

1. Top Channel In
2. Top Channel Out
3. Vacuum Chamber
4. Bottom Channel Out
5. Bottom Channel In



Top View

2 Specifications

This section includes specific technical information and operational requirements. Included are system dimensions, thermal requirements for operation, and gas requirements.

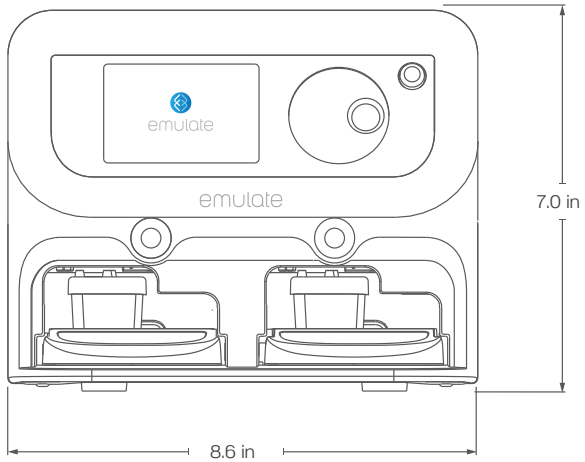
Zoë-CM1™

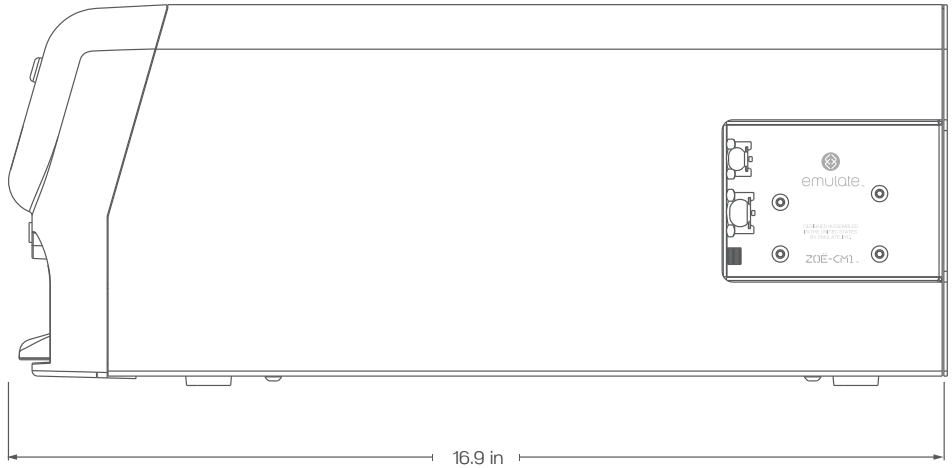
Specifications

Manufacturer Emulate, Inc., 27 Drydock Avenue, Boston, MA 02210

Assistance For technical assistance, contact Emulate, Inc., support@emulatebio.com

Use The Zoë™ Culture Module is for research use only





General	**Model:** CM1 **Weight:** 9.1 kg (20.0 lbs) **Instrument Rating:** 12 VDC, 5 A
Operating Requirements	**Electrical Power:** 100–240 VAC, 50–60 Hz **Gas Input Pressure:** 275.8 kPa + / - 34.5 kPa (40 psig + / - 5 psig) **Gas Input Composition:** 5% CO_2, balance air **Vacuum Input Pressure:** -70 kPa (-10.2 psig)
Environmental	**Operating Temperature:** 20–37.5°C (68-99.5°F) **Relative Humidity:** 0–85% RH **Max Altitude:** 2,000 meters (6,562 feet)
Technical	**Instrument Capacity:** 12 Pod™ assemblies **Flow Rate Ranges:** 0 µL / hr or 15–1,000 µL / hr **Max Organ-Chip Stretch:** 10% **Stretch Frequency:** Min: 0.01 Hz Max: 0.4 Hz

3 Safety

This section includes recommended precautions when handling and using the Zoë™ Culture Module. The information here describes how users can minimize any chance of harming themselves or the module while using the system. Regulatory compliance information is also contained here.

Zoë-CM1™ Safety

REFER TO
INSTRUCTIONS

The Instructions Symbol

The product is marked with this warning symbol where it is necessary for the user to refer to the instructions in the user guide.

Regulatory Compliance and Testing

This product has been tested to the requirements of:

61010-1 (IEC, EN, CSA) Safety Requirements for Electrical Equipment for Laboratory Use
EMC Directive 2014 / 30 / EU, LVD Directive 2014 / 35 / EU
EN 61326-1, Electro-Magnetic Compliance (EMC)

CAUTION	Never attempt to maintain or sanitize the Zoë™ Culture Module without first disconnecting from the power source.
CAUTION	Vent and disconnect all gas connections before moving, sanitizing, or maintaining the Culture Module.
CAUTION	The Culture Module is heavy. Exercise care when moving and verify that all work surfaces can support it. Incubator shelving may not support the Culture Module when shelving is partially pulled out of incubator.
CAUTION	Never insert fingers or foreign objects into the Bays. Injury or instrument damage may result.
CAUTION	Always follow in-house safety protocols before handling compressed gas.
CAUTION	Users are responsible for the proper disposal of any single-use components that have come into contact with biological material.
CAUTION	Service and maintenance should only be completed by Emulate-certified personnel. Never attempt to disassemble or repair the Culture Module.

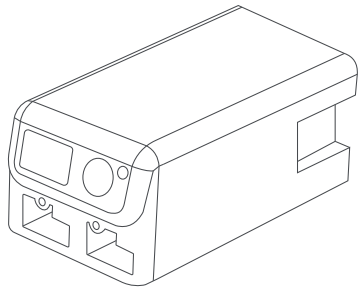
4 Installation

This section describes the items included with the Zoë™ Culture Module, the items provided by the user, and the steps involved in installation. Accessories included are two Trays, Vacuum and Gas Lines, and a Power Cable. A few items must be provided by the user. Contact Emulate for any guidance with such items. The installation process is described in 10 simple steps.

This operation should only be performed by Emulate-certified personnel.

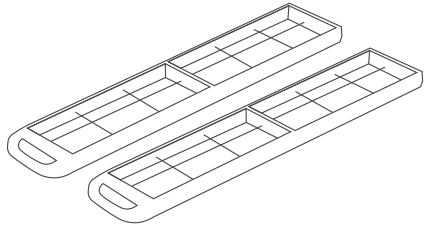
Equipment

Provided by Emulate



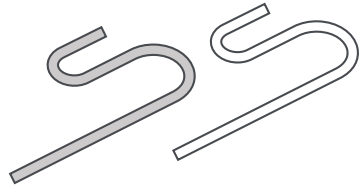
1

Zoë™ Culture Module



2

Trays



3

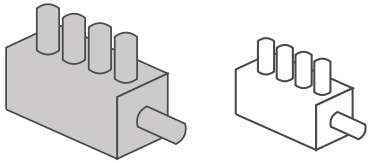
Vacuum & Gas Connector Lines

4

Power Cable

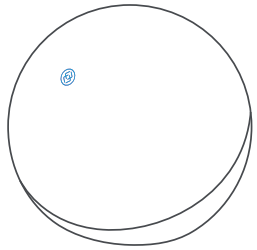
Equipment

Provided by Lab



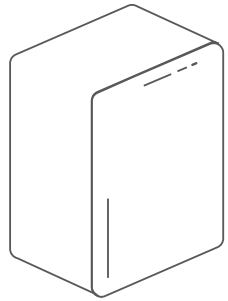
5

Vacuum & Gas Hubs



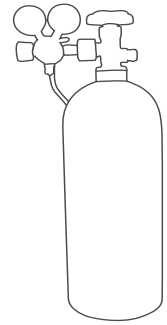
6

Orb™ Hub Module



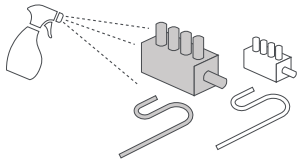
7

Incubator



8

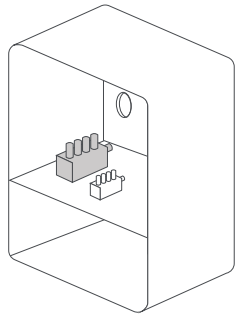
CO_2 Supply



1

Sanitize

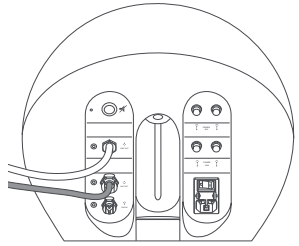
Sanitize Hubs and Lines



2

Place

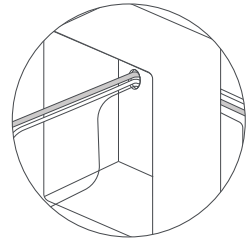
Place Hubs in incubator



3

Connect

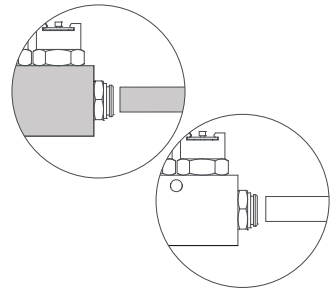
Connect Supply Lines to the Orb™ Hub Module



4

Run

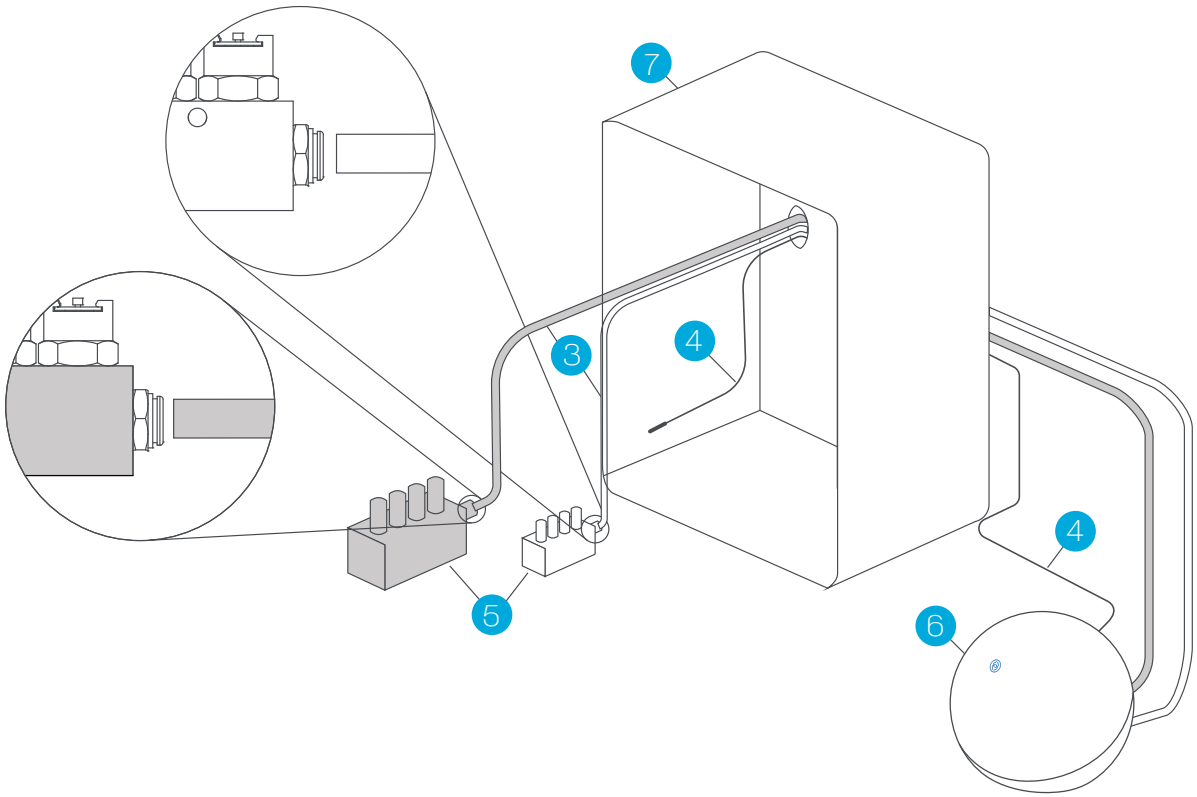
Run Supply Lines through incubator access port



5

Connect

Connect Supply Lines to Hubs

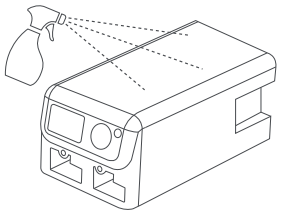


TIP:

Clean the inside of the incubator and incubator shelves with 70% ethanol.

TIP:

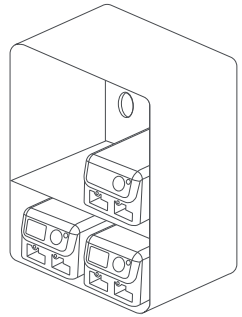
It is recommended to place the Orb™ Hub Module directly next to the incubator.



6

Sanitize

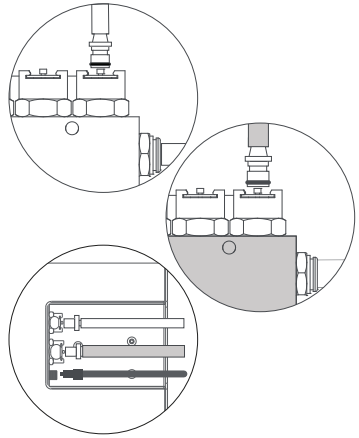
Sanitize the Zoë™ Culture Module exterior by wiping down all faces with 70% ethanol and lint-free cloth



7

Place

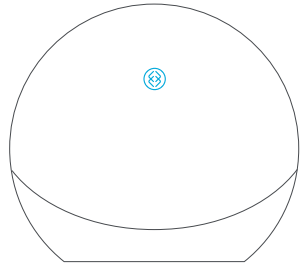
Place module(s) in incubator



8

Connect

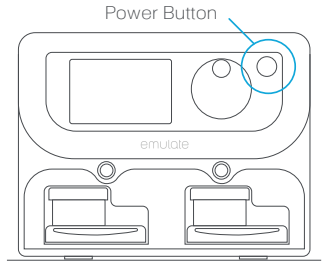
Connect module to Gas Hub, Vacuum Hub, and Power



9

Activate

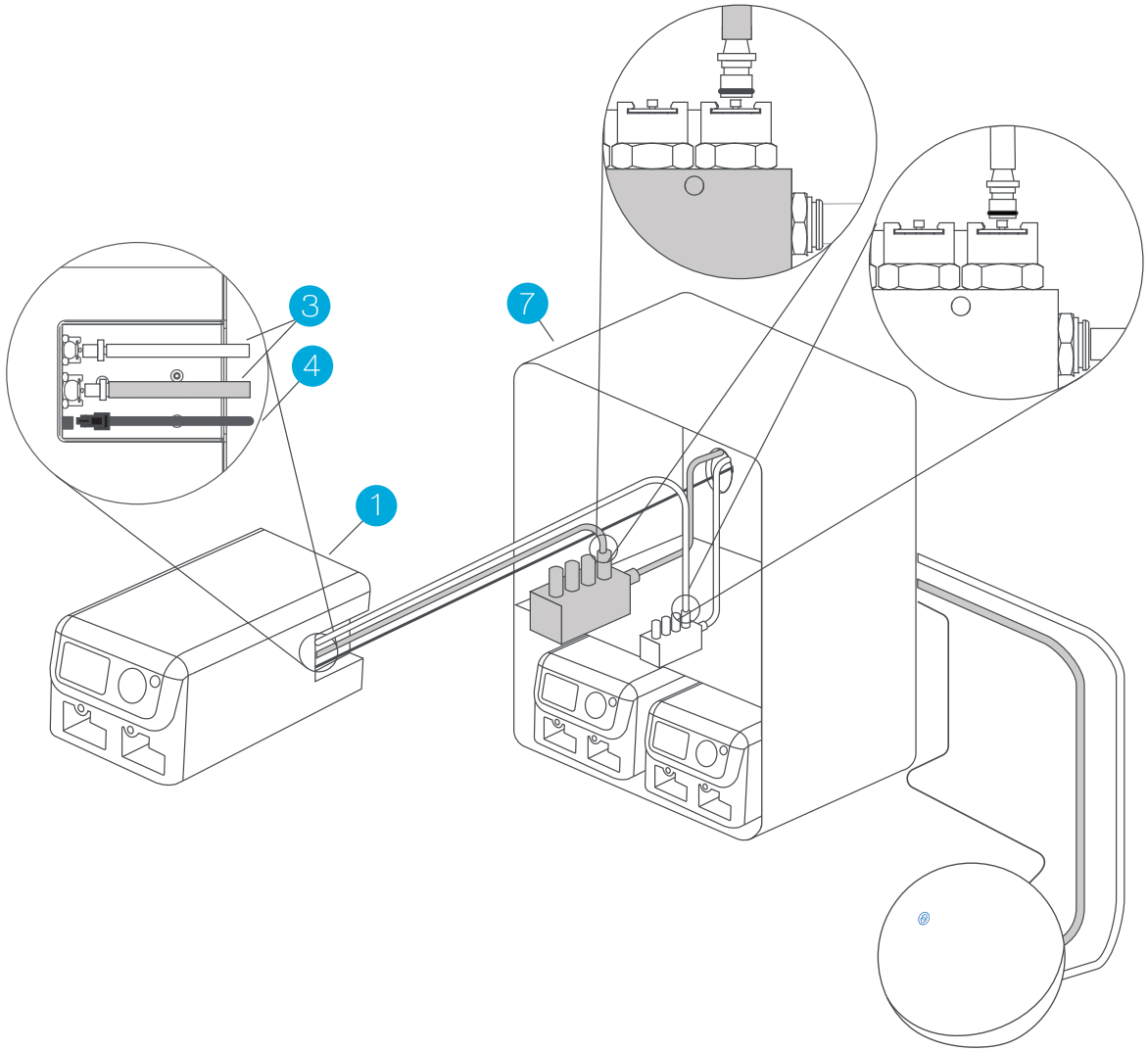
Activate the Orb™ Hub Module (refer to Orb User Guide for proper setup and use)



10

Power

Turn the module on



TIP:

When connecting the Gas or Vacuum Connector Lines to the Zoë™ Culture Module, listen and feel for the click-to-connect feedback ensuring the connection is complete.

CAUTION:

The Power Cable may disconnect from the module during installation. It may also disconnect if the module or incubator are moved. It is recommended to minimize any tension on the Power Cable.

TIP:

Vacuum and Gas Hubs are provided to split the Supply Lines into four module Connector Lines. Place the Vacuum and Gas Hubs inside the incubator.

TIP:

Close the incubator door and allow the module and incubator to equilibrate before beginning organ culture, which takes approximately four hours.

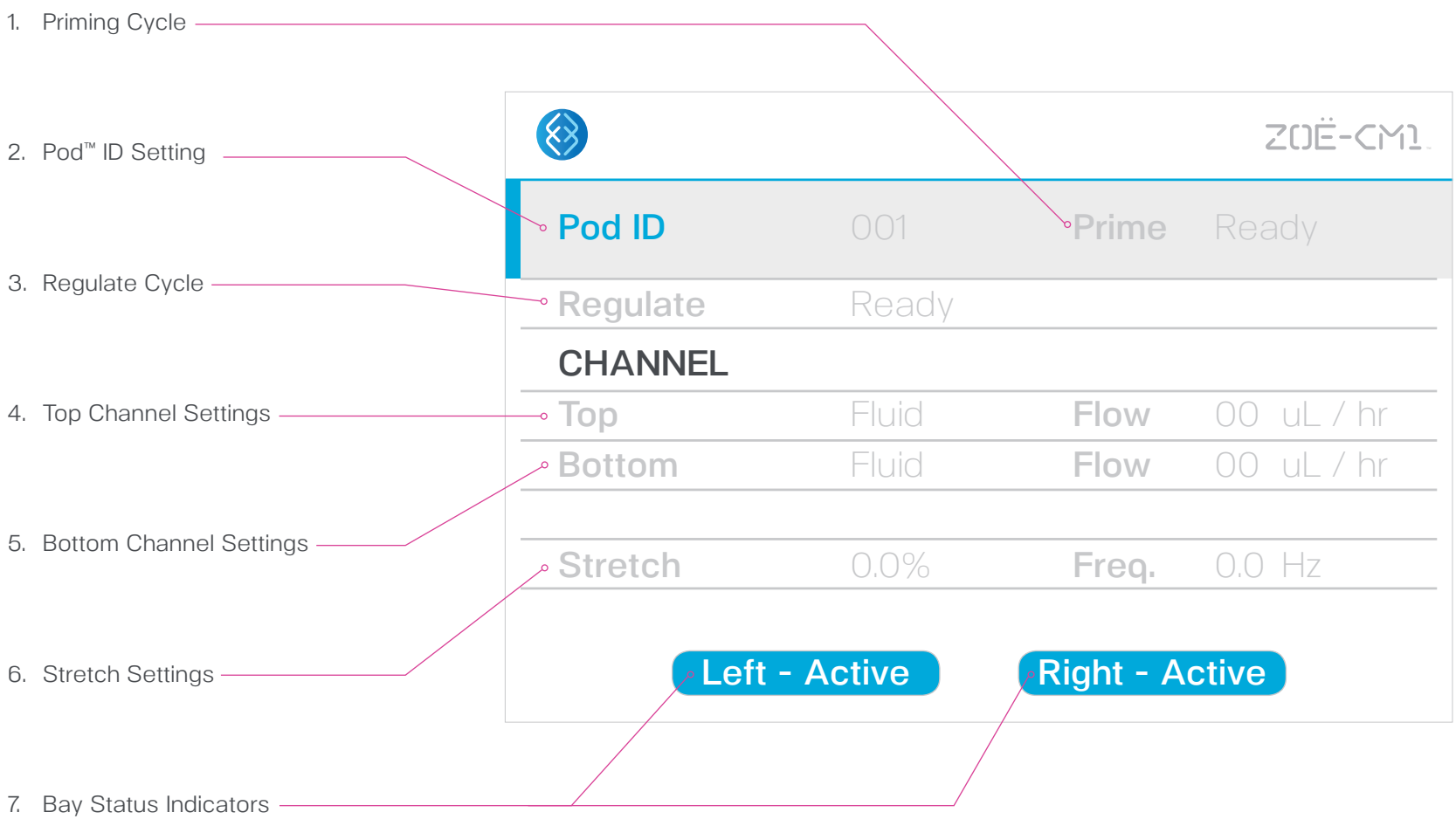
5 Programming

This section describes how to interact with the Zoë™ Culture Module's user interface (UI). The UI provides the current status of the module and offers settings that are defined by the user, including flow rate and stretch parameters. This section details the steps to execute various Pod™ assembly and Organ-Chip preparation processes, including Priming and the Regulate Cycle. All Culture Module settings are controlled through the user interface.

User Interface

Settings and Controls

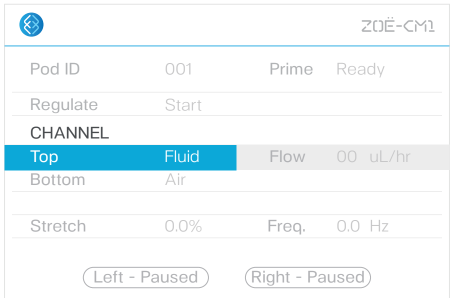
The Zoë™ User Interface (UI) is used to adjust all settings. The appropriate Pod™ ID settings are included in the individual chip preparation protocols. Priming and Regulate Cycles are initiated using the UI and Dial. The Top and Bottom Channels can be set to “Fluid” or “Air,” and the flow of each channel can be set individually. Stretch settings, including percent and frequency, are set using the UI and Dial as well. The Bay Status Indicators show the current statuses of the Left and Right Bays. “Active” bay status indicates the Pod assemblies are locked in place and “Inactive” bay status indicates the Pod assemblies are not locked in place and the Tray can be removed. When Bays are “Active,” all installed Pod assemblies are exposed to flow and stretch settings. Press the applicable Activation Buttons to change the state of the Bays. Bays automatically activate during Priming and Regulate Cycles.

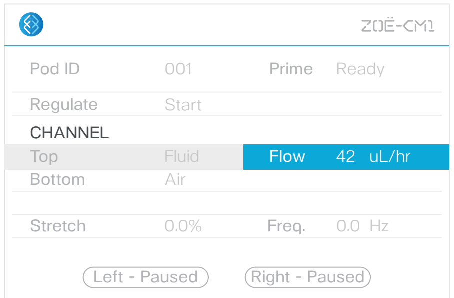

1. Priming Cycle
2. Pod™ ID Setting
3. Regulate Cycle
4. Top Channel Settings
5. Bottom Channel Settings
6. Stretch Settings
7. Bay Status Indicators
ZOË-CM1
Pod ID
001
Prime
Ready
Regulate
Ready
CHANNEL
Top
Fluid
Flow
00 uL / hr
Bottom
Fluid
Flow
00 uL / hr
Stretch
0.0%
Freq.
0.0 Hz
Left - Active
Right - Active

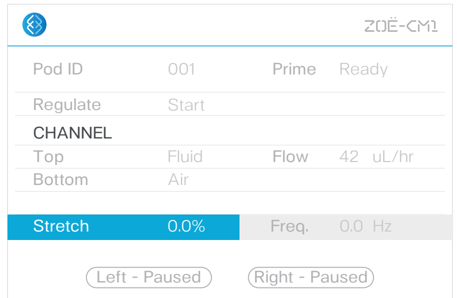
User Interface

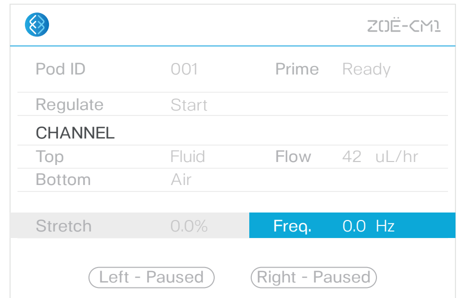
Organ-Chip Settings

Organ-Chip settings are customized using the UI and Dial. All Organ-Chips are subject to the same settings. Organ-Chip settings include media type of the Top and Bottom Channels, flow rate of the Top and Bottom Channels, stretch, and frequency. Media type refers to the material that will flow through the Top and Bottom Channels, and options include “Fluid” and “Air.” Flow refers to the rate at which the media flows through the Top and Bottom Channels, and only applies when the media type is set to “Fluid.” Flow units are microliters per hour and can be set to 0 µL / hr or any value between 15 µL / hr and 1,000 µL / hr. Note that the media contained in the Pod Reservoir will be utilized more quickly when the Flow is set to a high rate, which could result in running out of media and the introduction of air. Stretch refers to the mechanical strain applied to the Organ-Chip. Stretch has a range of 0–10%, and frequency has a range of 0.01–0.4 Hz. Stretch can be set to 0 if it is not needed. The Zoë™ Culture Module will save all Organ-Chip settings after being powered off.









1

Fluid or Air

Rotate the Dial, highlight Top or Bottom Channel, and press Dial. Rotate Dial to set to “Fluid” or “Air” and press Dial to set.

2

Flow

Rotate the Dial, highlight Flow of Top or Bottom Channel, and press Dial. Rotate Dial to set to desired Flow and press Dial to set.

3

Stretch

Rotate the Dial, highlight Stretch, and press Dial. Rotate the Dial to set to desired Stretch and press Dial to set.

4

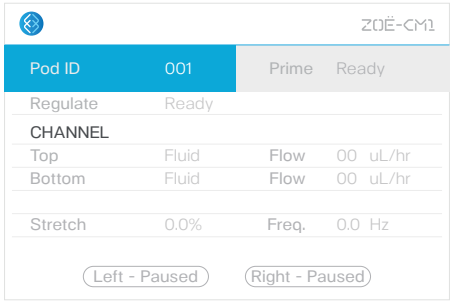
Frequency

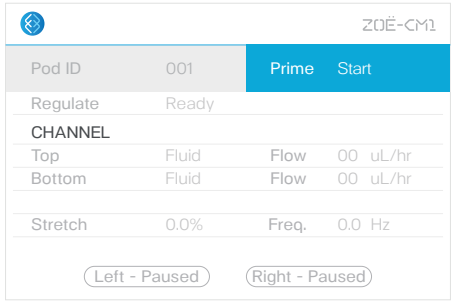
Rotate the Dial, highlight Frequency, and press Dial. Rotate the Dial to set to desired Frequency of stretch and press Dial to set.

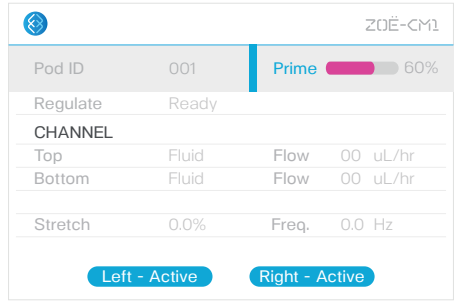
User Interface

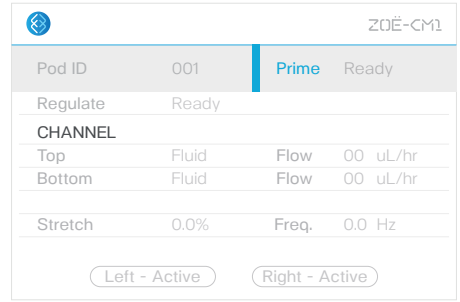
Priming

Priming is done prior to inserting the Organ-Chip and Chip Carrier into the Pod™ assembly. Priming is a 60-second process that fills the Pod Channels with the media contained in the Pod Reservoir eliminating any air segments within the Pod assembly. Priming will generate droplets of media at each of the four Pod Ports. The Organ-Chip and Chip Carrier are inserted into the Pod assembly after Priming is complete.









1

Set Pod™ ID

Rotate the Dial, highlight Pod ID, and press Dial. Rotate Dial to display the appropriate Pod ID and press Dial to set Pod ID.

2

Start Prime

Rotate the Dial, highlight Prime, and press Dial. Rotate Dial to display “Start” and press Dial to begin Prime.

3

Wait

Close the incubator door while priming is running. Prime status indicator provides real-time progress of Prime.

4

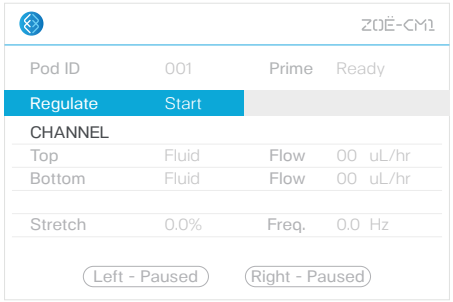
Ready

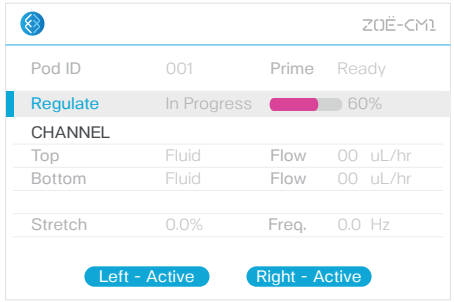
When priming is complete, the progress indicator is no longer displayed and the UI reverts back to the original view.

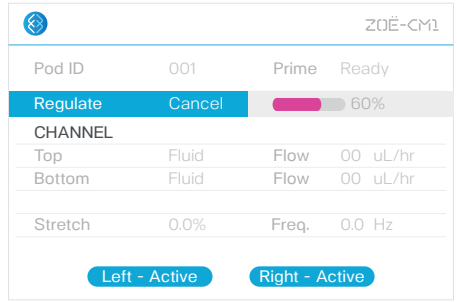
User Interface

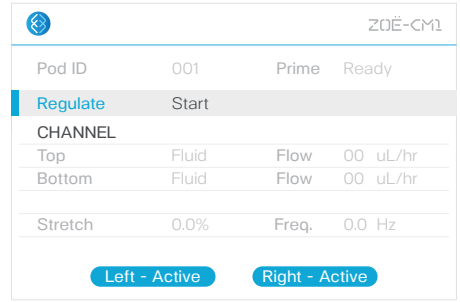
Regulate Cycle

The Regulate Cycle is run after inserting an Organ-Chip and Chip Carrier into a Pod™ assembly. The Regulate Cycle is a two-hour process that eliminates any bubbles that may have been introduced during the chip connection process. Organ culture flow will automatically begin at the end of the Regulate Cycle. Flow and other Organ-Chip parameters are set by the user. If low flow or bubbles are observed, the Regulate Cycle can be run again. The Regulate Cycle may be cancelled at any time. Cancelling the Regulate Cycle takes approximately 60 seconds. The Zoë™ Culture Module should not be turned off during the Regulate Cycle.









1

Start Regulate

Rotate the Dial, highlight Regulate, and press Dial. Rotate Dial to display “Start” and press Dial to begin Regulate Cycle.

2

Wait

Close the incubator door while the Regulate Cycle is running. Regulate status indicator provides real-time progress of Regulate Cycle.

3

Cancel (if needed)

To stop the Regulate Cycle, highlight Regulate and press Dial. Rotate Dial to display “Cancel” and press Dial.

4

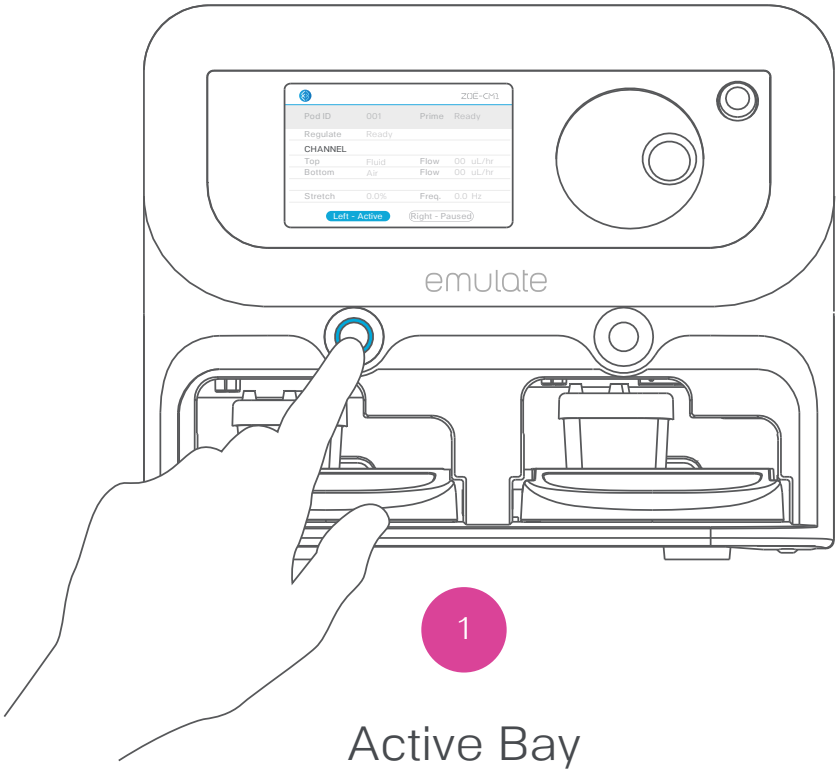
Ready

When the Regulate Cycle is complete, the progress indicator is no longer displayed and the UI reverts back to the original view.

User Interface

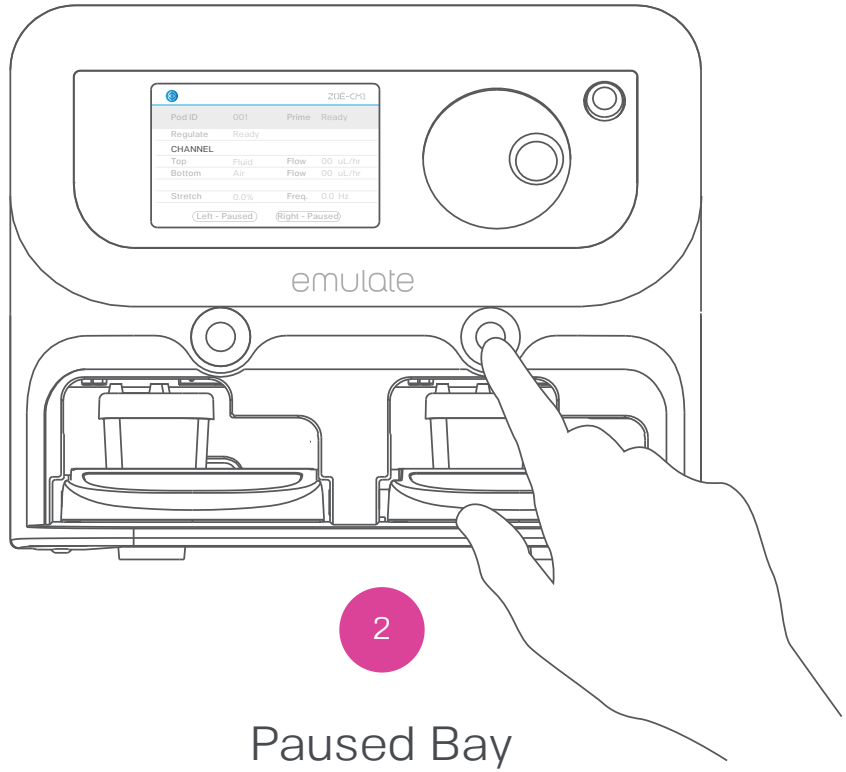
Bay Status

The Left and Right Bays are activated and deactivated using the applicable Activation Button. “Active” bay status indicates the Pod™ assemblies are locked in place and flow is being delivered. “Inactive” bay status indicates the Pod assemblies are not locked in place and the Tray can be removed; flow is not being delivered when Bay is “Inactive.” A Bay will not activate if there is no Tray installed. During Priming and the Regulate Cycle, the Bay(s) with a Tray installed will automatically activate. After Regulate Cycle concludes, the Bay(s) will remain “Active” and deliver flow and stretch in accordance with the Organ-Chip settings. Do not insert fingers or foreign objects into the Bays.



Active Bay

When the Bay is “Active,” the LED surrounding the Activation Button will illuminate and the Pod™ assemblies in the Bay will be locked in place.



Paused Bay

Press the Activation Button to change the state of the Bay. Bays are inactive by default.

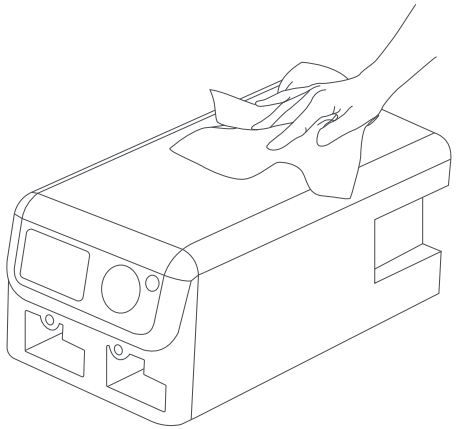
6 Care

This section details how to ensure the Zoë™ Culture Module functions as intended. Care includes periodic cleaning of the module and accessories, as well as regular checks and record keeping. Additionally, troubleshooting information is contained here.

Care

Cleaning & Maintenance

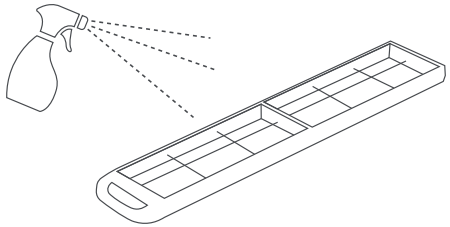
The Zoë™ Culture Module does not require significant maintenance. However, clean the exterior of the module and Trays with 70% ethonol prior to each use. The module should be cleaned in place and not removed from the incubator. All maintenance activities should be recorded in a lab notebook or equivalent.



1

Clean

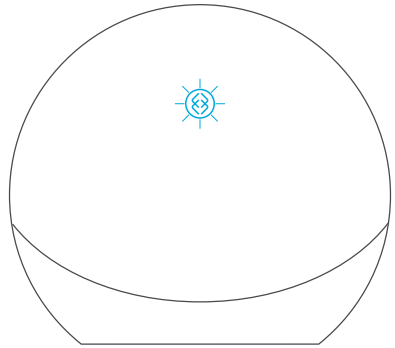
To clean the Zoë™ Culture Module, spray with 70% ethanol and wipe thoroughly with a lint-free cloth.



2

Sanitize

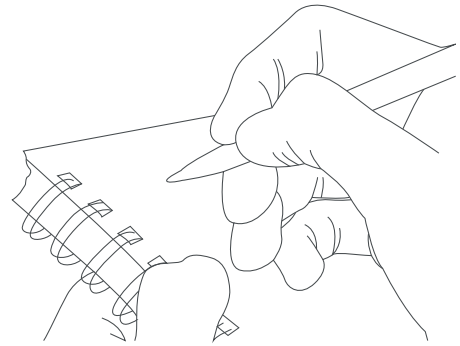
Before each use, sanitize the Trays with 70% ethanol.



3

Check

Confirm the Orb™ Hub Module Main Status Indicator is pulsing blue.



4

Record

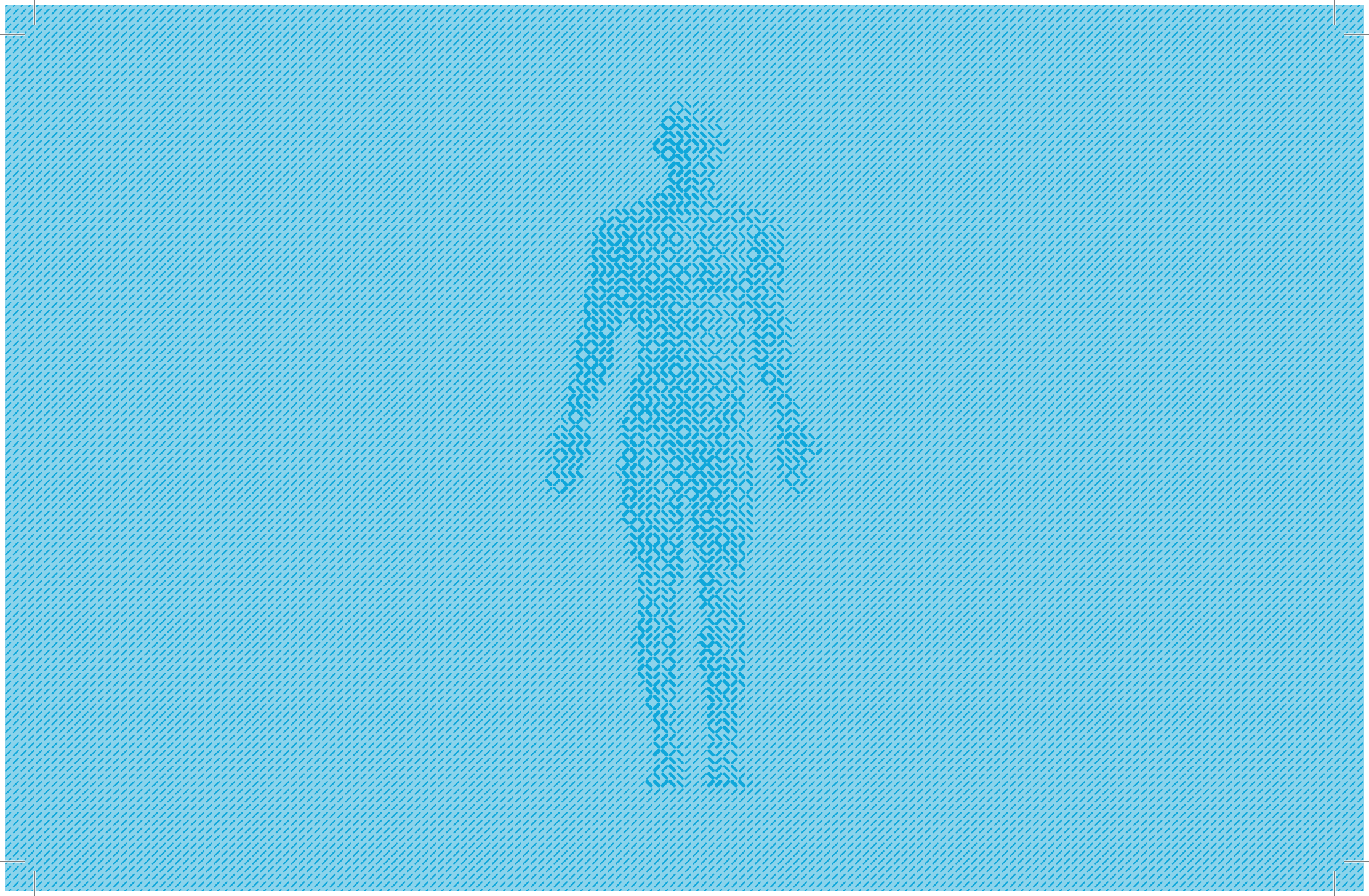
Keep a record of all maintenance and cleaning activities.

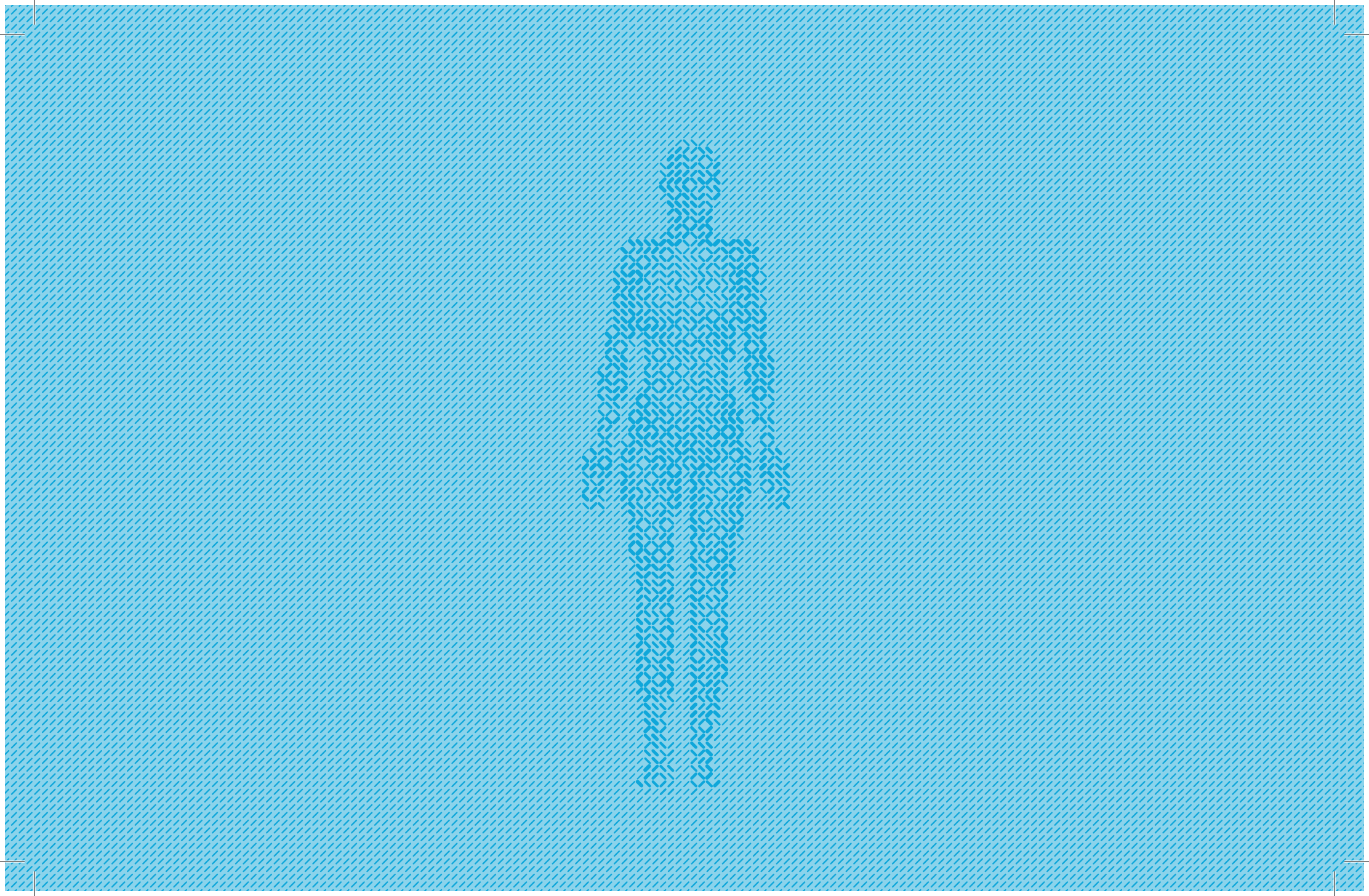
Care

Troubleshooting

Refer to this troubleshooting table for specific causes of and solutions to possible problems. In the event this table does not contain a problem you encounter, contact Emulate for additional troubleshooting.

Problem	Cause	Solution
Zoë™ Culture Module will not power on	The Power Cord has become unplugged from the Zoë Culture Module	Confirm the Power Cord is fully connected to rear of Zoë Culture Module
	The Power Cord is not connected to the Orb™ Hub Module or connected incompletely	Connect the Power Cord securely to the Orb Hub Module
	The Orb Hub Module is powered off	Refer to the Orb User Guide
	The fuse in the system is blown	Contact Emulate for troubleshooting
	The Power Cord is damaged	Replace Power Cord; contact Emulate for replacement
Bay will not activate	Bay is empty or Tray is not fully inserted into the Bay	Insert Tray until the Tray snaps into place
	Gas Connector Line is not connected to Zoë Culture Module or not connected to Gas Hub	Connect the Gas Connector Line to rear of the Zoë Culture Module and the other end of the Gas Connector Line to the Gas Hub
	The Orb Hub Module is powered off	Refer to the Orb User Guide
Bay will not de-activate	Bay was activated with empty Tray inserted, and empty Tray was removed before de-activating Bay	Insert empty Tray and press the Activation Button
Pod™ Lids are getting stuck in the Bays	Labels or stickers have been applied to the tops of the Pod Lids	Nothing should be applied to or stuck to any Pod Lids





emulate™