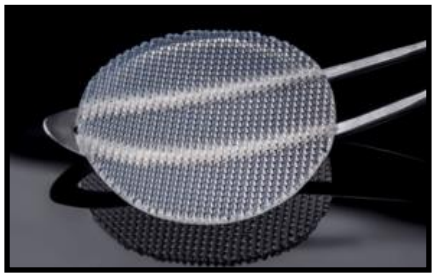
3D CoSeedis™

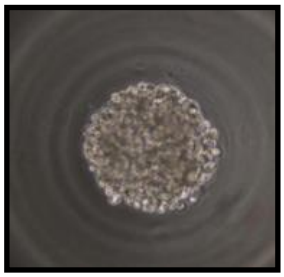
Easy Mass Production of Uniform and Homogenous Organoids for Predictive Disease Modelling

3D CoSeedis™ Standard Protocol

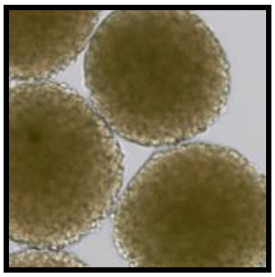
3D CoSeedis™ Chip200 and Chip880, compatible with 6-well plates



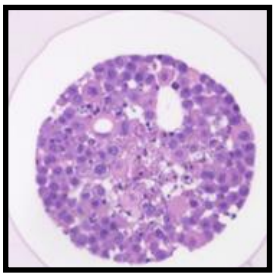
3D CoSeedis™ Chip880
for 6-well plates, ⌀ 34 mm



Spheroid in a microwell,
phase contrast



Harvested spheroids

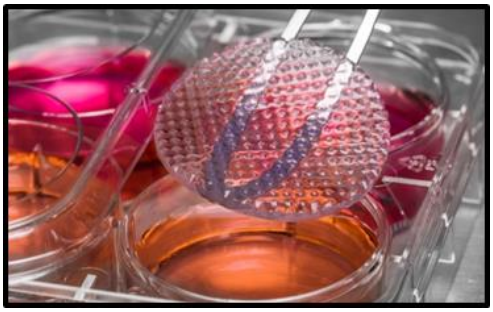


Paraffin section (H&E)

Order information

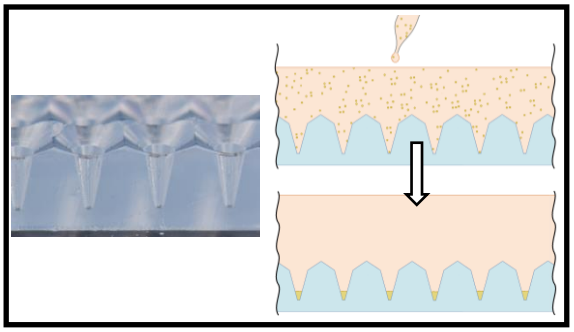
Component	Qty	abc biopply P/N
3D CoSeedis™ Chip200, 1 chip for 200 organoids in 1xPBS w/o Ca^{2+}/Mg^{2+}	1	C200
3D CoSeedis™ Chip880, 1 chip for 880 organoids in 1xPBS w/o Ca^{2+}/Mg^{2+}	1	C880
3D CoSeedis™ Chip880-6, 6 chips for 880 organoids in 1xPBS w/o Ca^{2+}/Mg^{2+}	1	C880-6
Spatula for 3D CoSeedis™ C200/C880, sterile	1	SPT-V1117

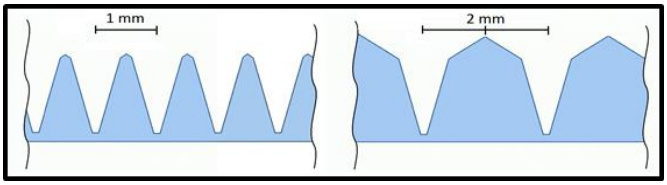
Introduction



3D CoSeedis™ Chip200 or Chip880, a 3-dimensional (3D) agarose-based co-culture system from ***abc biopply*** can be used in standard cell culture plates (6-well plates, see below). The system enables easy and economic seeding, cultivation and evaluation of 3D cell aggregates.
The system is intended for research only.

The agarose matrix forms a framework of conically shaped cavities and is seeded with cells in suspension. Since agarose repels and prevents cells adhesion, they sediment to the bottom of each cavity where they form hundreds of aggregates per chip.

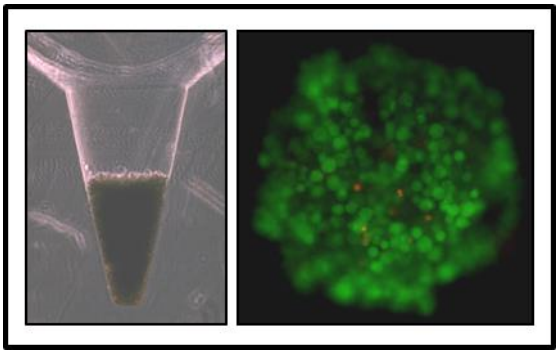




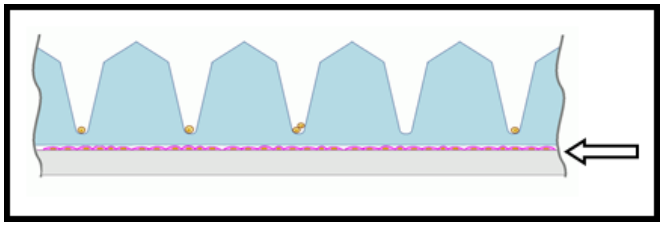
3D CoSeedis™ Chip880 3D CoSeedis™ Chip200

There are two different 6-well plate frame-works available: (1) 3D CoSeedis™ Chip200 for 200 3D cultures, (2) 3D CoSeedis™ Chip880 for 880 3D cultures. In addition, ***abc biopply*** offers a third 24-well plate framework for 680 3D cultures (P/N: C680; see protocol 3DCS_SP_C680).

Agarose is permeable to gases, nutrients and metabolites. Feeding of the cells therefore happens mainly via diffusion. Similarly, cytokines, dyes and other small molecules can easily diffuse through the matrix.



PI/FDA staining to label living and death cells in chip



Depending on the type of experiment, different cell types can be seeded and cultured in the cavities of the chip. Furthermore, it is possible to co-culture the cells in the chip with underlying adherent feeder cells or particles (arrow). Those may provide growth and other factors (via diffusion) while being physically separated from the cells in the chip.

Technical details

The chips are provided in 1xPBS w/o Ca^{2+}/Mg^{2+}.

	3D CoSeedis™ Chip880	3D CoSeedis™ Chip200
distance between the centre of 2 microwells	1 mm	2 mm
no. of microwells/cm²	100 microwells/cm²	25 microwells/cm²
total no. of microwells/chip	~ 880 microwells	~ 200 microwells
diameter of microwell at the bottom	212 µm	212 µm

Required material

- 6-well plates with a well diameter of at least 34 mm
  Note: the following plates show the appropriate dimensions and are suitable for 3D CoSeedis™: Corning® Costar®, Falcon®, greiner bio-one CELLSTAR®, Nest®.

- Spatula for 3D CoSeedis™ C200/C880, sterile (P/N: SPT-V1117)

Sterilisation via autoclave or immersion in 70% Ethanol (non-denatured)

- Cell strainer (pore size 40 µm)
- Hemocytometer or alternative cell counting device
- Trypsin/EDTA (P/N: PEL-PB-LU-002-0100)
  Alternative: Accutase (P/N: PEL-PB-PAACUTASE)
- Vacuum suctions device and fitting pipettes
- Serological pipettes and according pipetting device
- Cell culture growth medium incl. supplements
  Note: we recommend 2.5% serum for 3D cultures. Higher concentrations for clonal growth only.
- Centrifuge for microtiter plates
- Analysis tool for cell seeding and volumetric analysis
  (free download at: https://biopply.com/support/analysis-tool/)

Protocol

(1) Equilibration of agarose chip(s) in 6-well plates: 2¼ h

The agarose chip is delivered in single-packaged aluminium bag containing 1xPBS w/o Ca^{2+}/Mg^{2+}. Alternatively, bulk quantities of chips (P/N: C200-6 or C880-6) are delivered and stored in plastic beakers containing 1xPBS w/o Ca^{2+}/Mg^{2+}.
In order to create the proper environment for cells to grow in, the chip needs to be equilibrated before seeding:

(a) Add 4 ml of growth medium into a well of a fresh 6-well plate (see above for correct plate dimensions).
(b) Transfer chip into the medium. If equilibrating multiple chips, apply 1 chip per well. Use spatula (P/N: SPT-V1117) to manipulate chips.
(c) Centrifuge plate for 3 – 5 minutes at 200 g to remove air bubbles.
(d) Equilibrate chip(s) for at least 2 h (to overnight) in a 37°C, humidified incubator.
➛ Chip(s) will take up the colour of the medium.

(2) Plated cell number and cell suspension:

When choosing the number of target cells per microwell (cpm), those general guidelines apply:

- For cell types that grow well only in larger numbers per microwell, a multicellular start is recommended (e.g. HepG2, Hep3B).
- Cells that grow well in an anchorage-independent manner (which is the provided environment in 3D CoSeedis™ microwells) can be seeded from 1 cpm to more than a 1 000 cpm.

3D CoSeedis™ Chip200:

- This chip contains 25 cavities/cm^2. Each cm^2 will be seeded with 1 ml of cell suspension.
  ➛ To seed 1 000 cpm, we need 25 x 1 000 = 25 000 cells per 1 ml.
  ➛ Each well has a surface area of approximately 9.5 cm^2. Therefore, we need 9.5 x 25 000 = 237,500 cells in 9.5 ml of cell culture medium.

Cells/micro-well	Cells/ml medium	Comment	Cell suspension per chip
100	2 500	The lower the cpm, the less homogenous the starting aggregates.	9.5 ml lower volumes will lead to a less homogeneous cell distribution across the chip
200	5 000	-	
500	12 500	standard for radiation/chemo experiments with cancer cells	
1 000	25 000	-	
2 000	50 000	-	
5 000	125 000	medium change at least every 2nd day	

3D CoSeedis™ Chip880:

- This chip contains 100 cavities/cm^2. The density of cell aggregates is therefore relatively high. Consequently, cells may suffer from starvation more easily than in the 3D CoSeedis™ Chip200. The 3D CoSeedis™ Chip880 is ideally suited for lower cell numbers.
- If the aggregates are harvested after a few days already, seeding cell numbers per cavity can be as high as 1 000 cells.
- Each cm^2 will be seeded with 1 ml of cell suspension.
  ➛ To seed 0.35 cpm, we need 100 x 0.35 = 35 cells per 1 ml.
  ➛ Each well has a surface area of approximately 9.5 cm^2. Therefore, we need 9.5 x 35 = 333 cells in 9.5 ml of cell culture medium.

Cells/micro-well	Cells/ml medium	Comment	Cell suspension per chip
0.35	35	standard for clonal growth and colony formation	9.5 ml lower volumes will lead to a less homogeneous cell distribution across the chip
1	100	possible cell densities for clonal growth/colony formation after cytotoxic treatment	
10	1 000		
100	10 000		
1 000	100 000	medium change at least every 2nd day	

(3) Prepare cells: ½ h

Please visit our web site (www.biopply.com) to download an excel spreadsheet to assist in cell dilutions.

(a) Detach cells from 2-dimensional (2D) flask/dish according to standard protocol (e.g. Trypsin/EDTA, P/N: PEL-PB-LU-002-0100).
(b) Pass cell suspension through cell strainer (pore size 40 µm).
(c) Determine cell density (cells/ml) by using a hemocytometer (or any other alternative cell counting device).
(d) Dilute cells in medium to the required density for seeding chip(s):
    - for colony forming assays and limited dilution experiments, use 10% serum
    - for all experiments with higher cell densities, use 2.5% serum
    Note: when aggregates should be cultured for several weeks, it is recommended to test even lower serum concentrations if not to dispense with serum altogether. In 3D CoSeedis™ Chips, cells tolerate much lower serum concentrations than in 2D conditions (autocrine supply of factors).

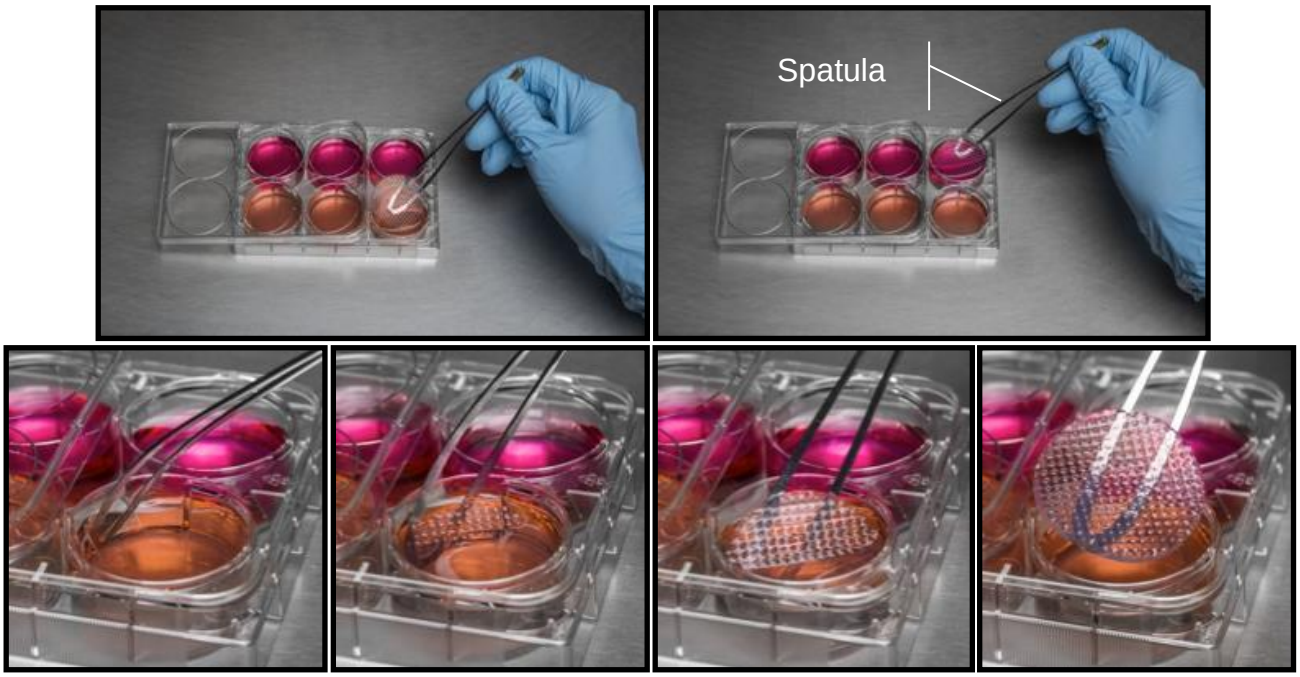
(4) Seeding cells: ½ h

(a) Remove equilibration medium from chip(s) only **after** the cell suspension is ready.
Important: after the equilibration medium has been removed, each chip needs to be seeded with cell suspension within a few minutes. Long exposure of chip(s) to air will lead to precipitates.
(b) Add 9.5 ml of cell suspension/well.
Note: apply the suspension to the centre of each chip.
(c) After seeding, we recommend to leave the 6-well plate in the sterile cabinet for at least 20 minutes before transferring it to the incubator. This will allow most cells to settle down.
(d) Transfer the 6-well plate to incubator to allow cells to sediment completely. Do not disturb 6-well plate for at least an hour. Ideally, cells are allowed to settle down for 8 hours to overnight.

(5) 1st medium change: < ¼ h

When changing the medium for the first time, all *chip(s) are transferred into a new 6-well plate*. This will get rid of adherent cells that attached to the plastic of the 6-well plate when cells were initially seeded.
Cell densities for clonal cell growth do normally not require media changes. Nevertheless, transferring the chip(s) to a new 6-well plate after seeding is recommended.

(a) Add 4 ml of fresh medium to each well of a new 6-well plate.
(b) Lift chip(s) from the old 6-well plates by using the spatula for 3D CoSeedis™ C200/C880 and transfer it into the medium of the new 6-well-plates (eventually, push chip(s) down with spatula – careful!):



(6) Subsequent medium changes: **< ¼ h**

For subsequent medium changes, it is not required to transfer the chip(s) to new 6-well plates.

(a) Remove old medium by using a vacuum suction device.
Note: careful not to damage the chip and not to lose any cells!
(b) Add 4 ml of fresh medium to each well of the 6-well plate. Do apply medium to the side wall of each well.
Note: careful to not flush the cell aggregate out of their cavities!

(7) Harvesting of organoids: **< ¼ h**

It is possible to harvest 3D organoids for further processing such as:

- Single cell analysis
- DNA, RNA or protein extraction
- Re-embedding of 3D structures in alternative matrices
- High-throughput screening of individual 3D organoids
- Etc.

To harvest 3D cultures:

1. Lift chip(s) containing the organoids from the corresponding well as depicted above (step 5 (a) and (b)).
2. Flip it upside-down and put it back into a well containing either medium or any other physiological buffer for organoid collection (e.g. 1xPBS w/o Ca^{2+}/Mg^{2+}).
3. Centrifuge at 300 g for 30 seconds.
4. Lift off and discard empty chip(s).
   (Beforehand, make sure no 3D organoids are left behind in the chip – an additional centrifugation step may be required otherwise).
5. Organoids in the medium or buffer may now be collected for further processing using a serological pipette.

Cell type behaviour in the 3D CoSeedis™ cell culture platform

Name	Description	Type of 3D construct Sp = compact spheroids Lo = loose aggregates	Clonal growth of single cells without additional ECM*
A-549	Human lung adenocarcinoma	Lo	not tested
B16	Murine melanoma	Lo	+
BT-474	Human breast carcinoma	Sp	not tested
FaDu	Human hypopharyngeal carcinoma	Lo	not tested
GBM4	Human glioblastoma	Lo	+
Hep3B	Human hepatocellular carcinoma	Lo	(+)
HepG2	Human hepatocellular carcinoma	Lo	(+)
HT-29	Human colorectal adenocarcinoma	Sp	+
Huh-7	Human hepatocellular carcinoma	Lo	(+)
HuT-78	Human T lymphocyte	sedimented suspension cells	not tested
LnCap	Human prostate cancer	Lo	not tested
MCF-7	Human mammary cancer	Lo	-
MD-MBA-231	Human mammary cancer	Lo	-
Mesenchymal Stroma-Zellen (MSC)	Primary human cells from bone marrow and adipose tissue	Sp	-
MiaPaCa-2	Human pancreatic adenocarcinoma	Lo	+
MTPa	Rat mammary cancer	Sp	+
OE-19	Human esophageal adenocarcinoma	Sp	+
Panc-1	Human pancreatic adenocarcinoma	Lo	(+)

Name	Description	Type of 3D construct Sp = compact spheroids Lo = loose aggregates	Clonal growth of single cells without additional ECM*
PC3	Human prostate cancer	Lo	-
PSN-1	Human pancreatic adenocarcinoma	Lo	(+)
Raji	Human B lymphocyte	sedimented suspension cells	not tested
Snu	Human hepatocellular carcinoma	Lo	(+)
T 47D	Human mammary cancer	Sp	(+)
U251	Human glioblastoma	Sp	+
U266	Human multiple myeloma	Lo	-
WiDr	Human colorectal adenocarcinoma	Sp	+

*) clonal growth of adhesion-dependent cells can be stimulated through the addition of ECM particles

Note: the following cells show poor cell growth under standard conditions (i.e. without feeder support and other adaptations):

- *MaMel 63a*
- *MaMel 47*
- *FLO-1*
- *OAC-P4C*