



Rik de Vries

rik.devries@wetsus.nl

## Motivation

Providing high-quality water in sufficient quantities is a growing challenge that currently affects both developed as well as developing countries. Reverse osmosis (RO) membrane filtration is a state-of-the-art method to gain high quality water (Fig. 1). However, challenges remain to improve the operation of membrane filtration.

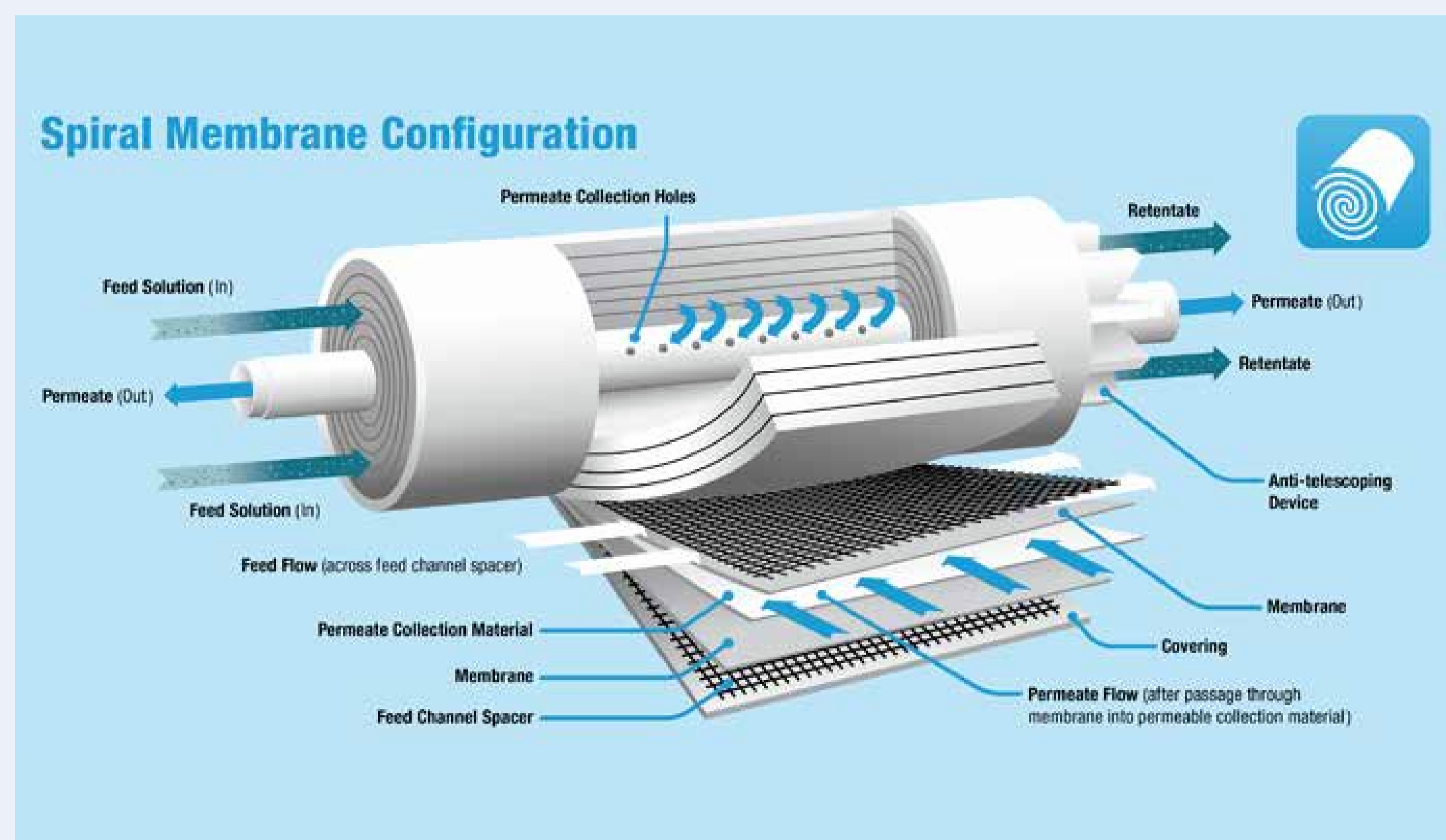


Figure 1. Membrane filtration in spiral configuration.\*

In general, membrane filtration is negatively affected by fouling, which is the accumulation of particles at the membrane (Fig. 2). Biofouling, caused by accumulating micro-organisms, is a frequently observed obstacle for membrane filtrations. Therefore, much effort is provided to reduce biofouling, and in particular the bacterial production of extra-cellular polymeric substances (EPS).



Figure 2. Membrane fouling: an unwanted phenomenon.

## Approach

The membrane fouling simulator (MFS) is representative for large scale RO membrane filtration systems and will be used to simulate biofouling under various operational designs to determine how biofouling is effected (Fig. 3). For the MFS experiments, a variety of pure, dual and mixed cultures will be used to relate the degree of biofouling to pre-determined bacterial physiologies. These bacterial physiologies will be investigated via plate-assays that screen for specific bacterial phenotypes, such as biofilm formation (Fig. 4).

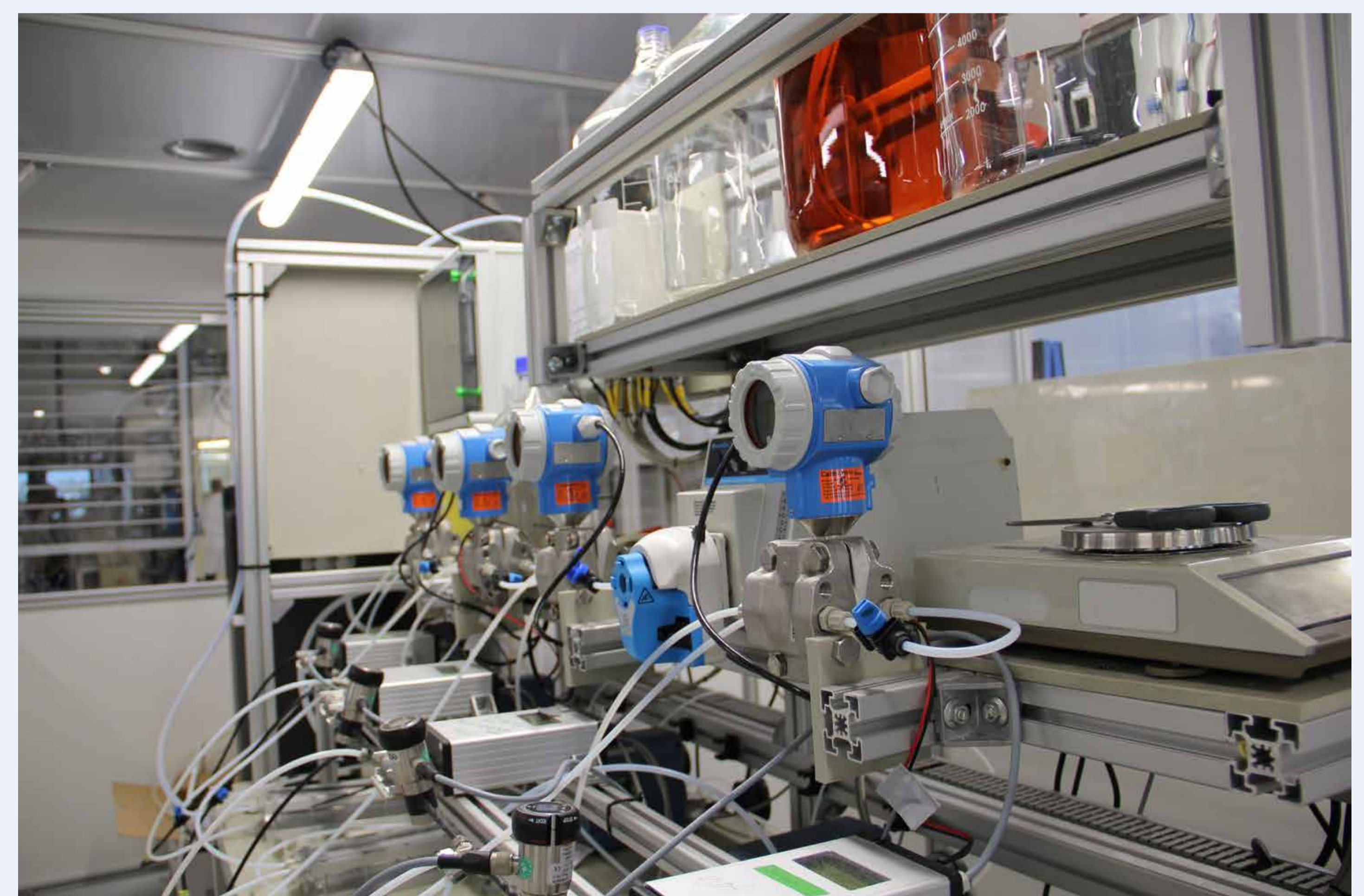


Figure 3. The membrane fouling simulator.

## Objective

The aim of this project is to reduce biofouling and improve the operation of RO membrane filters. The following objectives have been established:

- Determination of which bacterial physiological characteristics are important for biofouling.
- Determination of which nutritional conditions trigger EPS production.
- Determination of how operational design (temperature, salinity, start/stop, and shear strategies) can be applied for biofouling removal.

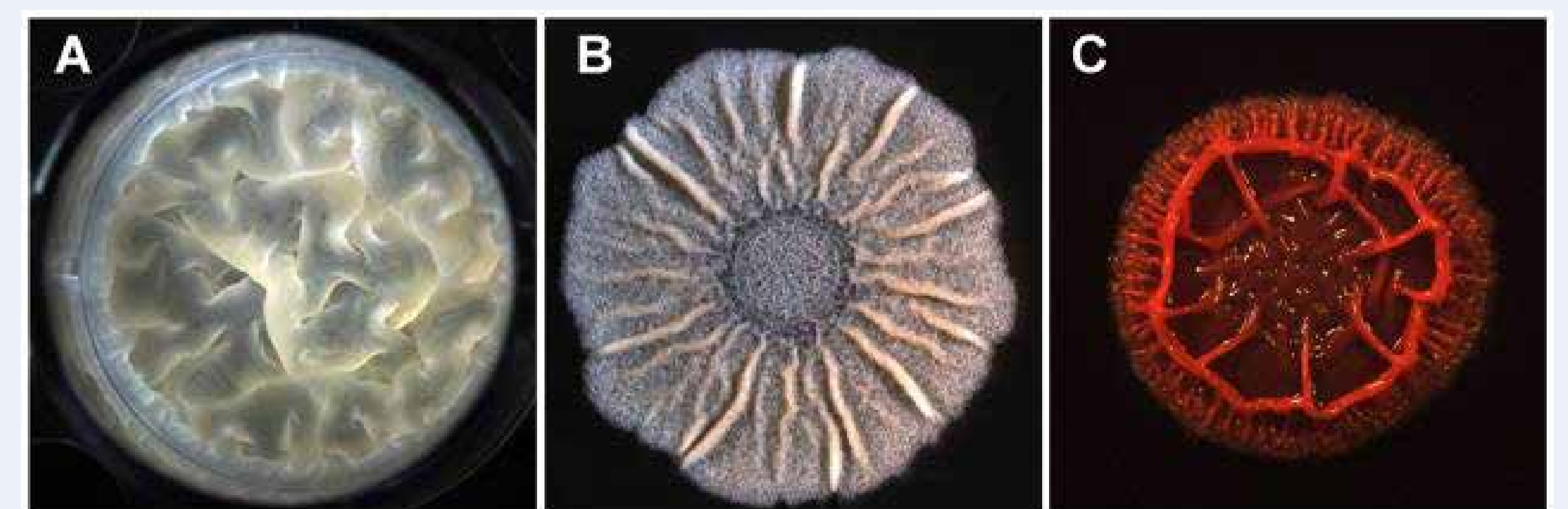


Figure 4. *Bacillus subtilis* biofilm formation on solid surface.\*\*

\* [www.kochmembrane.com/Learning-Center/Configurations/What-are-Spiral-Membranes.aspx](http://www.kochmembrane.com/Learning-Center/Configurations/What-are-Spiral-Membranes.aspx)

\*\* Romero, D., et al., Antibiotics as signal molecules. *Chemical reviews*, 2011. 111(9): p. 5492-5505. (Picture courtesy of Dr Liraz Chai).