EXPERIMENTAL EVOLUTION : High Temperature Adaptation of E.Coli

Student(s)

Ezgi Altun
Ara Kris Ütücü

Faculty Member(s)

Prof. Dr. Zehra Sayers

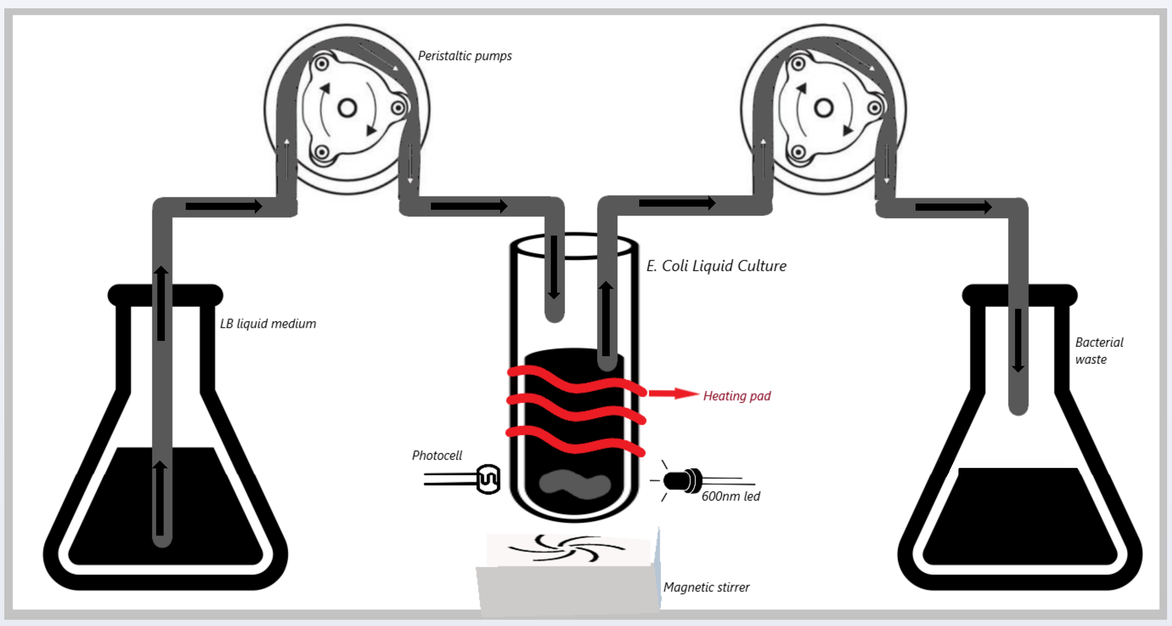
Supervisors

Kerem Bora
Emine Süphan Bakkal
Gökşin Liu

Sabancı Üniversitesi
FACULTY OF ENGINEERING AND NATURAL SCIENCES

PURE

Abstract



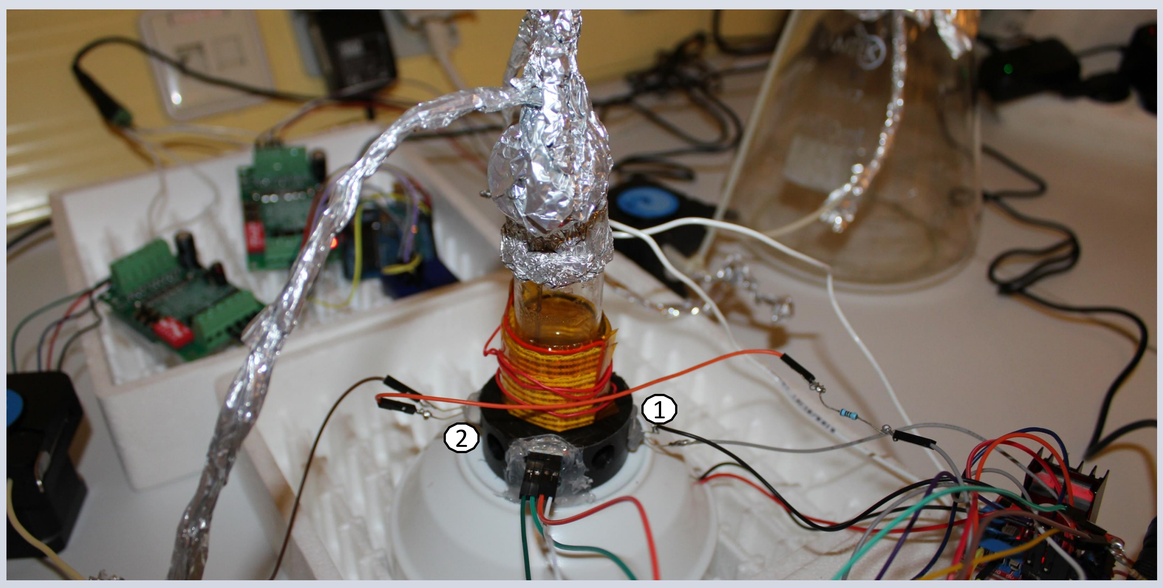
The change in the genetic composition of populations over time is called *'evolution'*. Since a large number of generations is required to observe the genetic response to altered conditions, microorganisms are quite popular in this field. For example, a bacteria dividing every 30 minutes will produce its 1440th generation descendant in a month. Therefore, we have built a device inspired by a chemostat which enables precise control of the selective pressure under which organisms evolve and it facilitates experimental control of cell growth rate *(1).*

Our device which can be seen in a drawing representation above is a continuous liquid culture for microorganisms and it maintains a constant level of growth on evolving bacterial populations. In this specific device, bacterial populations are evolving in temperature dependent manner. In other words, our selective pressure is temperature.

Objectives

The aim of this project is to create a set up in which evolutionary processes of microorganisms can be carried out. This setup/device is designed to be used by experimental microbiologists on their evolutionary researches.

Project Details

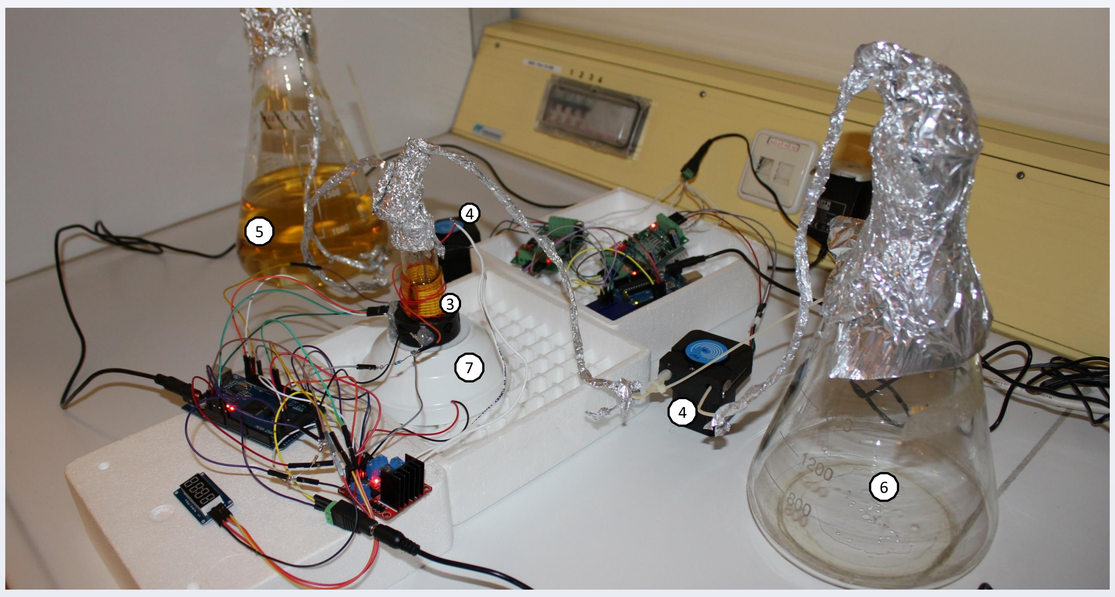


Working volume of the chemostat is 20 ml. The tube surrounded with wires seen above is a continues liquid culture where E.Coli bacterias are incubated. The growth rate measurements are done by using an optical detection system *(2)* that is based on measuring the intensity of led light from bacterias suspended in liquid culture.

1- Feature labelled as 1, is a led light which has a wavelength of 660nm.

2- Feature 2, a photocell is placed right opposite of the led light. Photocell measures the optical density through the bacterial cells in the culture, which corresponds to the density of the bacterial population in the culture tube.

Project Details



3- Heating pad uses electrical resistance as a heating source and it keeps the system at around the set temperature. A temperature sensor constantly checks the current temperature of the bacterial culture.

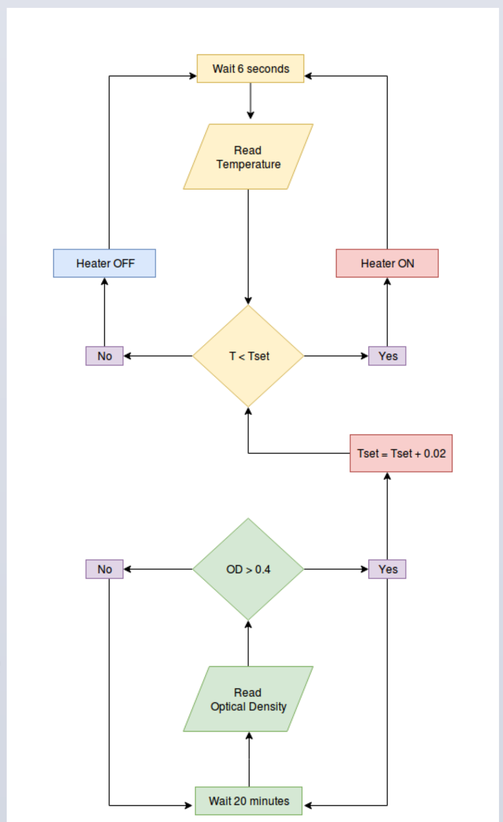
4- Peristaltic pumps ensure the liquid transmission between the LB broth medium***(5)*** and the tube in where evolving bacterial cells are suspended as well as between the tube and the flask for the bacterial wastes***(6);*** by using peristaltic movements just like in humans' large intestine. Peristaltic pumps allow the liquid transmission for 6 ml in 1 hour.

7- Feature 7 is a continuous magnetic stirrer which provides us to stir the culture without contaminated it. A whirling magnet is placed under the culture tube as well an another magnet dropped in the culture tube. Two magnets affect each other in a magnetically which keeps the culture continuously stirred.

The whole system is maintained by two Arduinos, one is for controlling peristaltic pumps to allow 6 ml liquid circulation in 60 minutes.

Second Arduino provide a bit more complex operation: ⟹

This device checks the optical density of the culture. If the OD is higher than the set value (culture is adapted to new temperature), it increases the temperature set value by 0.02 C.



Future Work

The features of this set up can be redesigned to study different topics in evolutionary microbiology and the effect of various selective pressures can be investigated.

References

(1) **Gresham D, Jungeui Hong J.** *The functional basis of adaptive evolution in Chemostats.* FEMS Microbiology. 2015.

(2) **Toprak E, Veres A, Yildiz S.** *Building a Morbidostat: An automated continuous-culture device for studying bacterial drug resistance under dynamically sustained drug inhibition*. Nat Protoc. 2013.