From Environment to Production
Design, Modeling, and Development of Microbial Cell Factories (MCF)

1. Collect microbial samples in large scale from diverse environments such as marine, soil, and oil
   - Environmental samples are collected from coastal and offshore areas of the Red Sea, and nucleic acid is extracted directly from the microbial samples

2. Identify desired genes and metabolic pathways in microbe samples using metagenomic analysis and computational modeling
   - Extracted DNA is subjected to Next Generation Sequencing
   - Computational analysis of whole microbe genome and the 3D modeling of their proteins and metabolic networks is performed
   - Desired genes and metabolic pathways are determined

3. Edit and insert desired microbial genes into the genome of a suitable host using genome editing technologies
   - A sophisticated genome editing technology (CRISPR system) is utilized to edit specific sequences of microbe genes to obtain maximum desired properties
   - Using the same technology, the modified microbe genes are inserted at precise locations within the host genome

4. Express desired genes in suitable host for mass production of food, fine chemicals, and energy
   - The host (such as microalgae) transformed with bacterial genes are cultured to produce mass quantities of desired products

Fig. 1. A recent visit of Bill Gates to KAUST

Fig. 2. An example for single cell encapsulation in the droplet

Fig. 3. The colorful marine life in Red Sea. Sampling is done from Red Sea.

Fig. 4. Genome Engineering is used to create desired feature producers

Fig. 5. Laboratory Investment: Microscopes and high-speed cam

Fig. 6. Pipeline: from discovery to production

Instrumentation
Comparative Genomics and Genetics lab is investing to laboratory instrumentation:
- Single cell instrumentation
- Synthetic Biology (Genome Engineering)

Examples of the instrumentation:
- Nikon microscopes Ti-U & SMZ25
- High speed camera Photron SA-Z
- Fluigent pulseless microfluidic pumps
- Five different wavelength lasers

Our aim with the Single cell technology
- Discover new microorganisms, genes and pathways
- Resolve the heterogeneity in the Metagenomic sample
- Isolate single cells, amplify DNA/RNA and prepare sequencing libraries
- Use for high-throughput screens
- Select the desired cells after Genome Engineering
- Select improved enzymes