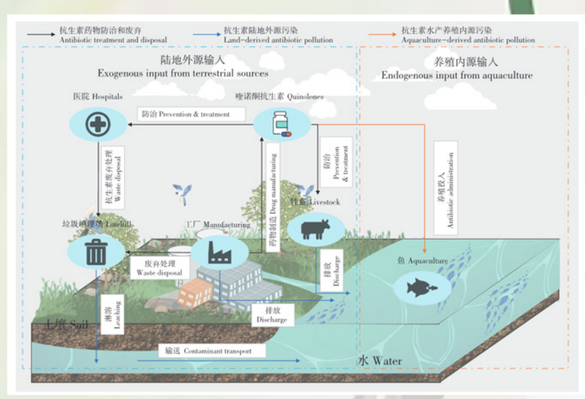
Establishment of a Comprehensive Control System for β-Lactam Antibiotics, Using Chlorella.

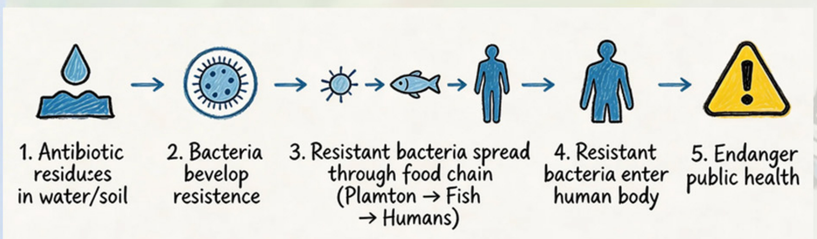
利用小球藻搭建β内酰胺抗生素综合防治系统

01 Background 研究背景



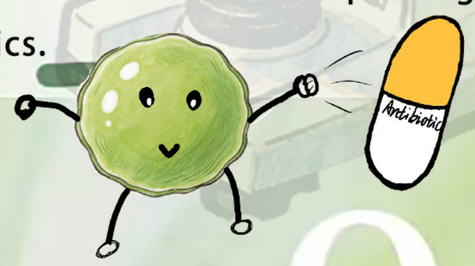
The stocking density in modern aquaculture systems often exceeds the ecological carrying capacity of the water body, leading to severe exceedances of pollutants such as total phosphorus and antibiotics.

the discharge of antibiotic pollutants into water bodies induces the horizontal transfer of antibiotic resistance genes, significantly enhancing the tolerance thresholds of pathogenic microorganisms to commonly used clinical antibiotics.



In summary, there is an urgent need for effective wastewater treatment solutions.

Common Chlorella can reduce total nitrogen in water, but its ability to remove antibiotics is extremely limited. We aim to engineer Chlorella to secrete beta-lactamase, enhancing its tolerance to high-antibiotic environments and improving its capacity to degrade antibiotics.



02 Module Design

1.To hydrolyze antibiotics: Introduce ELBLs into Chlorella

2.To detect antibiotics: Introduce the reporter module into Chlorella

Core Components

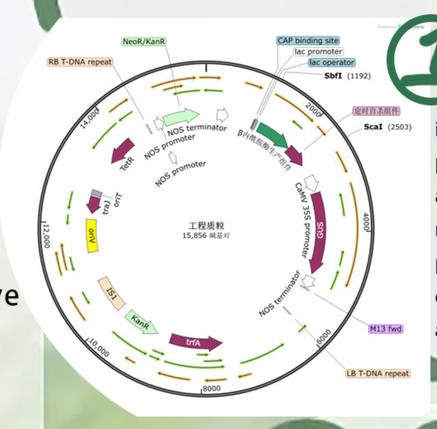
BBa_K2933001: β-lactamase production module

BBa_K2273108: Reporter module,

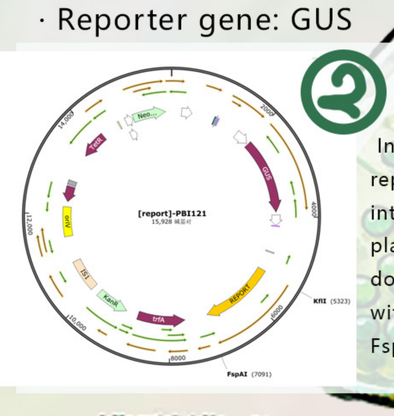
BBa_K4286103: Timed suicide module

Vector Selection and Modification

- PBI121 expression vector
- Promoter: CaMV 35S
- Terminator: NOS
- Selectable marker: NptII
- Reporter gene: GUS



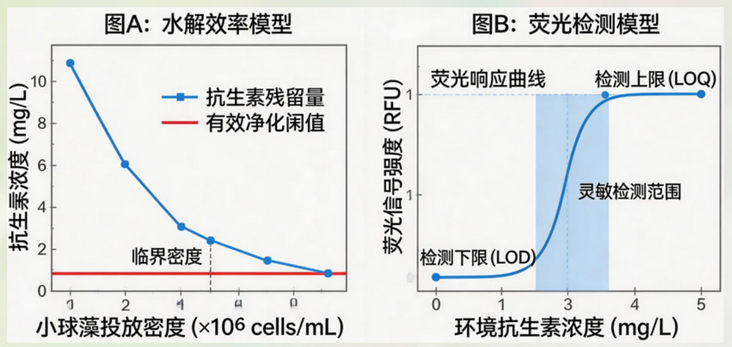
1 introduce β-lactamase production module and timed suicide module into PBI121 plasmid via double digestion with SbfI and ScaI



2 Introduce the reporter module into PBI121 plasmid via double digestion with KfiI and FspAI

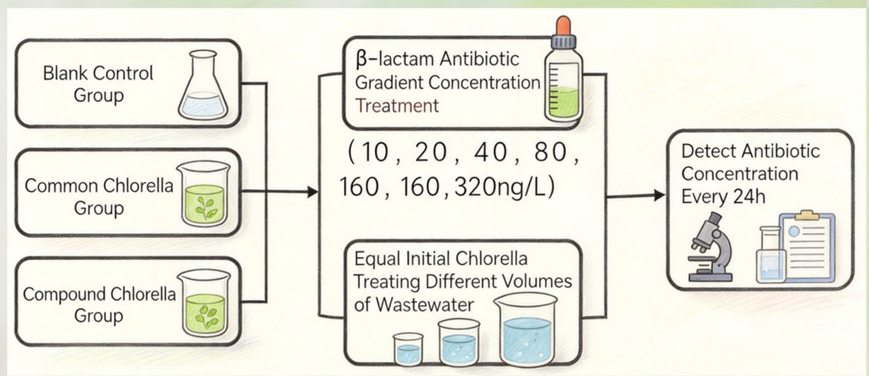
03 Model 模型搭建

We choose to adopt a mathematical modeling approach.

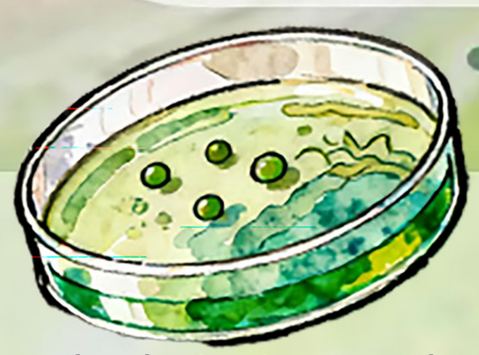


Construct models for antibiotic removal and detection in water bodies to simulate the effective purification volume corresponding to hydrolase production and the sensitive detection range corresponding to fluorescence signal intensity.

04 Experiments 实验方法



During the experiment, the process is dynamically monitored. The ability of composite Chlorella to degrade antibiotics in water can be evaluated. And a series of data on antibiotic degradation in water can be obtained for modeling.



05 PROSPECTS 前景展望

Given the complex nature of aquaculture wastewater, future efforts should focus on developing integrated treatment technologies that combine multiple biological materials to overcome the limitations of single-organism approaches. Starting with engineered Chlorella that secretes β-lactamase, we aim to build a comprehensive system for controlling beta-lactam antibiotics. Subsequent research will focus on optimizing enzyme expression, purity, and stability, while exploring the integration of additional beneficial genes. This will help establish a multifunctional microbial platform capable of the synergistic degradation of β-lactam antibiotics and other pollutants, ultimately paving the way for greener, and more sustainable strategies to combat antibiotic pollution.