

# BACTOKIDNEY

A Bacteria-based Micro-dialysis Machine

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NYMU-TAIPEI, TAIWAN

## Bacteria as Kidney

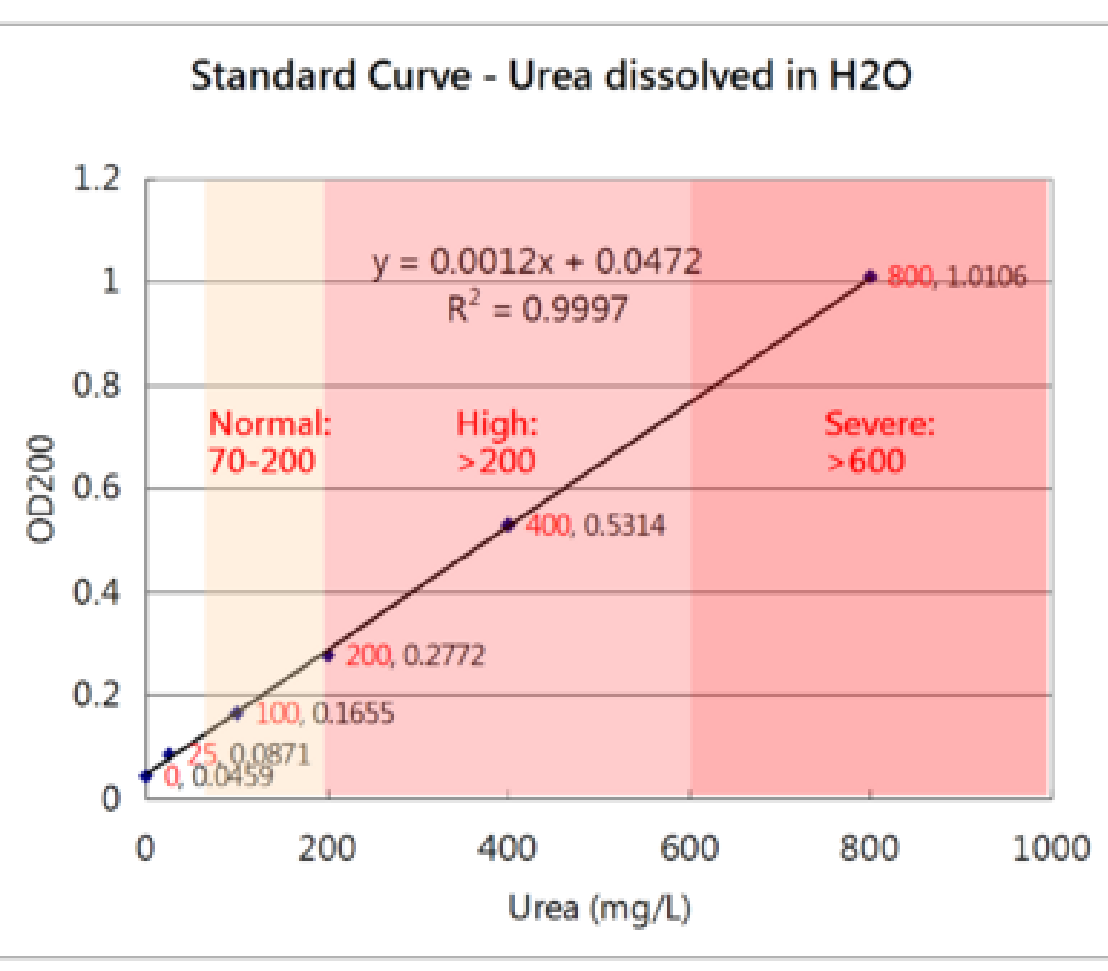
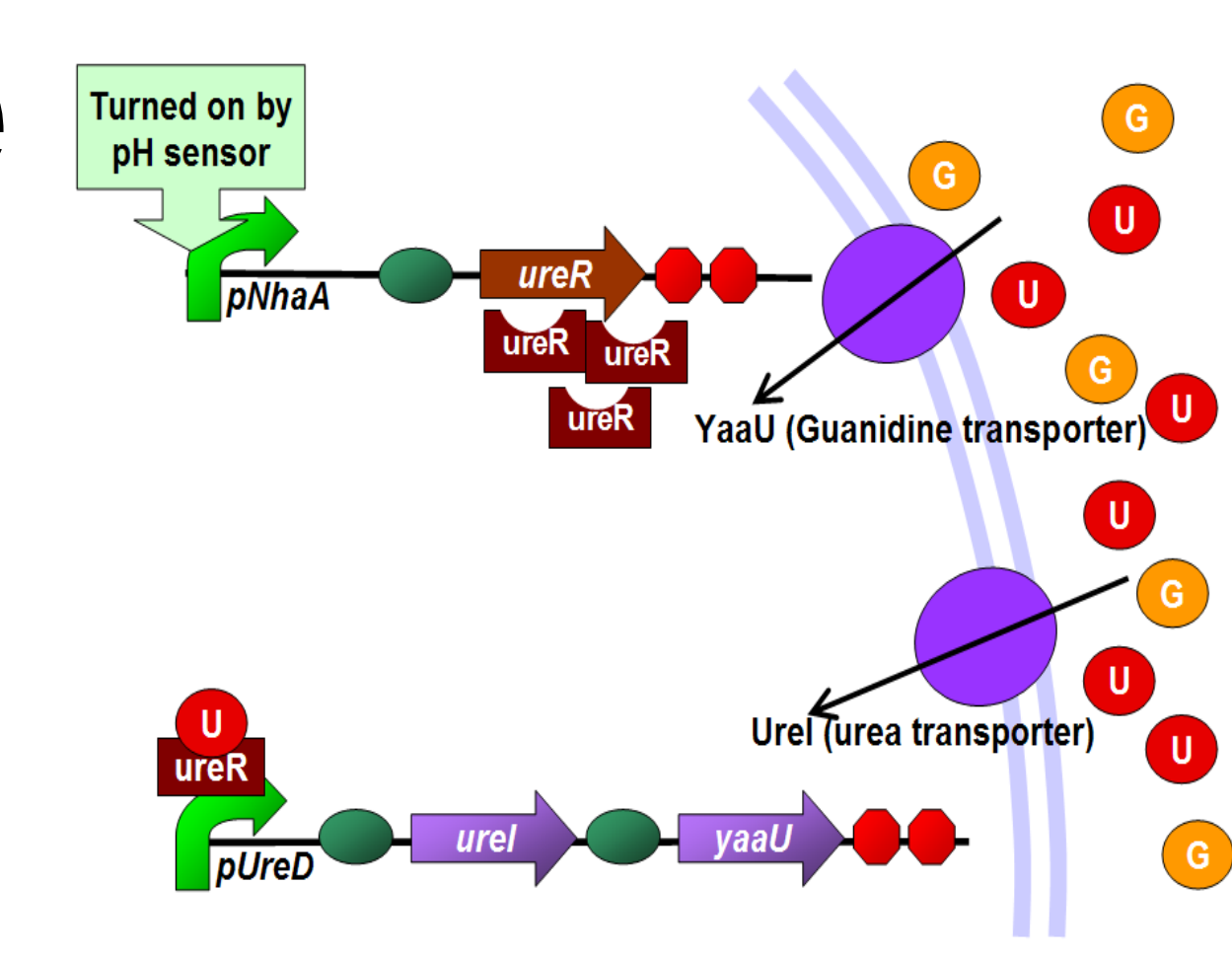
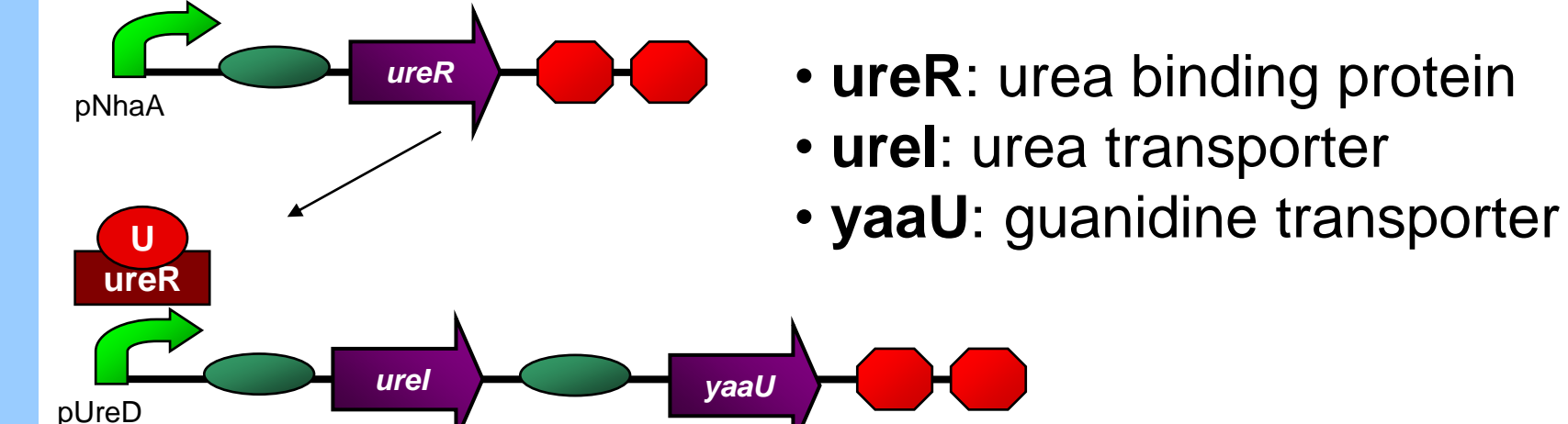
Chronic kidney disease (CKD) is one of the top ten causes of death in Taiwan. Patients of this disease must either have kidney transplantation or undergo a hemodialysis treatment to maintain their life. Hemodialysis patients must go to the hospital for treatment for a few hours once every few days. Because of this, they live a low quality of life.

**So BacToKidney is here to save the world!**

**BacToKidney — a bacteria-based micro-dialysis machine**

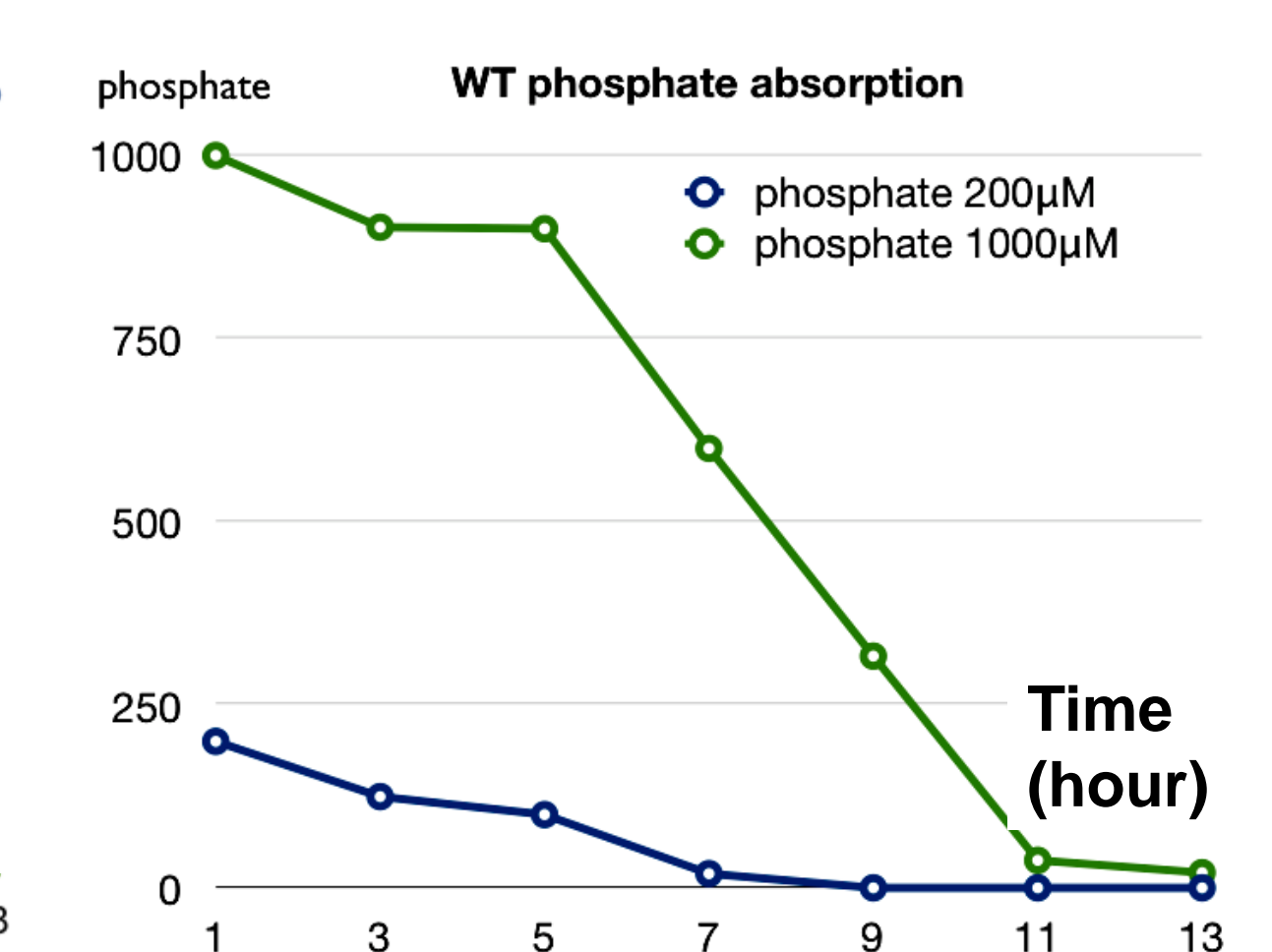
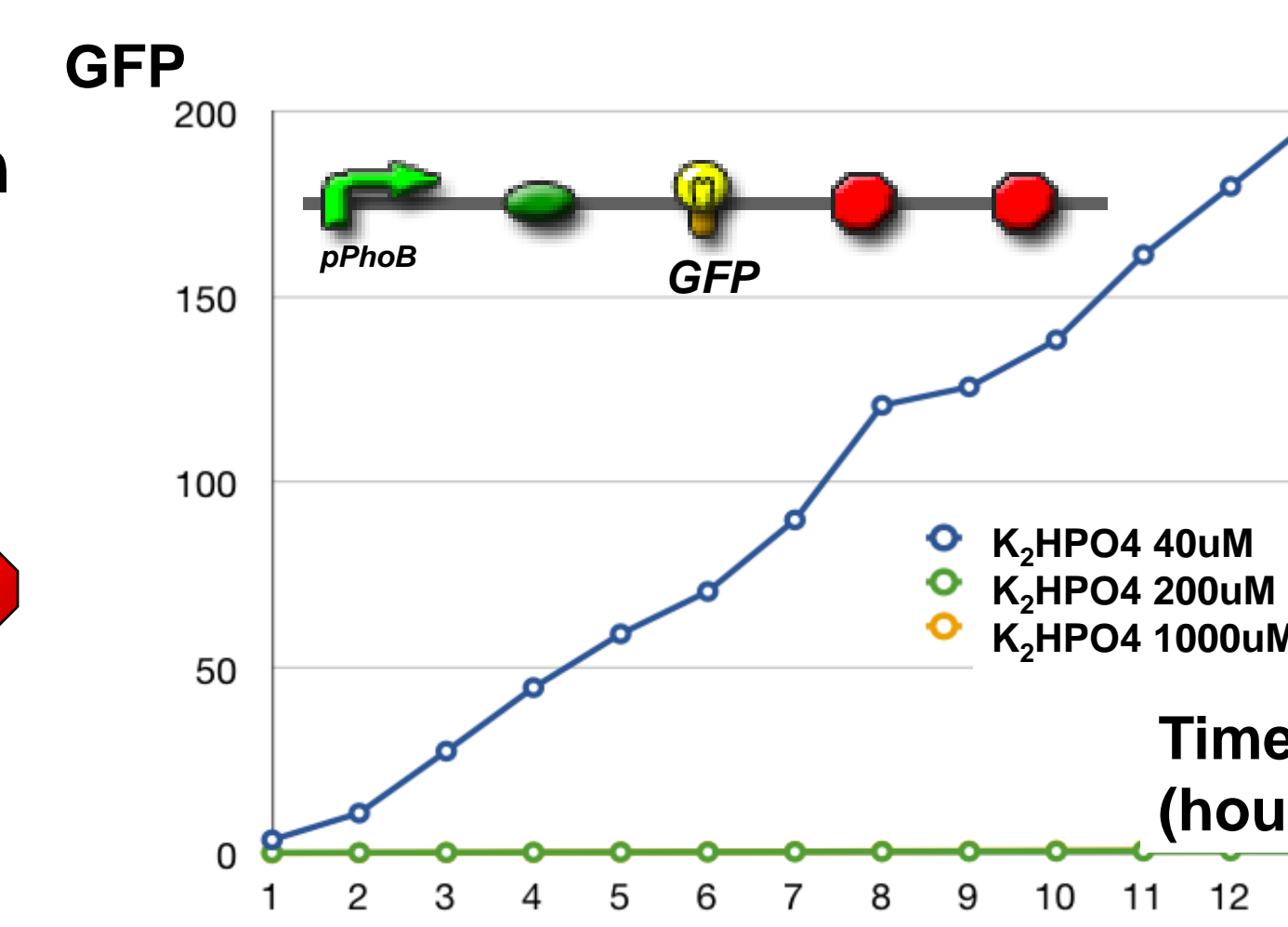
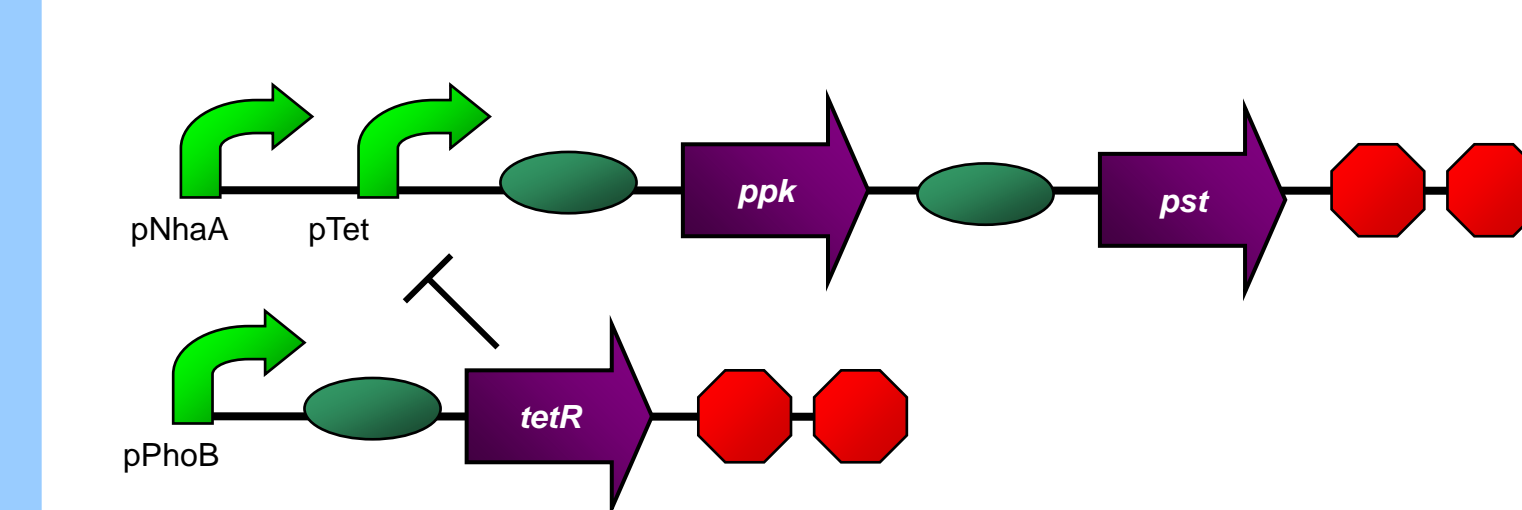
- **pH sensor** — Starts the work of BacToKidney in the intestine.
- **Attachment** — Attaches on intestinal epithelial cell.
- **Waste Removal** — Balances concentration of urea, guanidine, phosphate.
- **Time Regulation** — Calculates time to detach BacToKidney in time.

## Urea & Guanidine Removal Device



## Phosphate Balancing Device

- **Regulation for phosphate absorption**
- **Low phosphate security feedback**



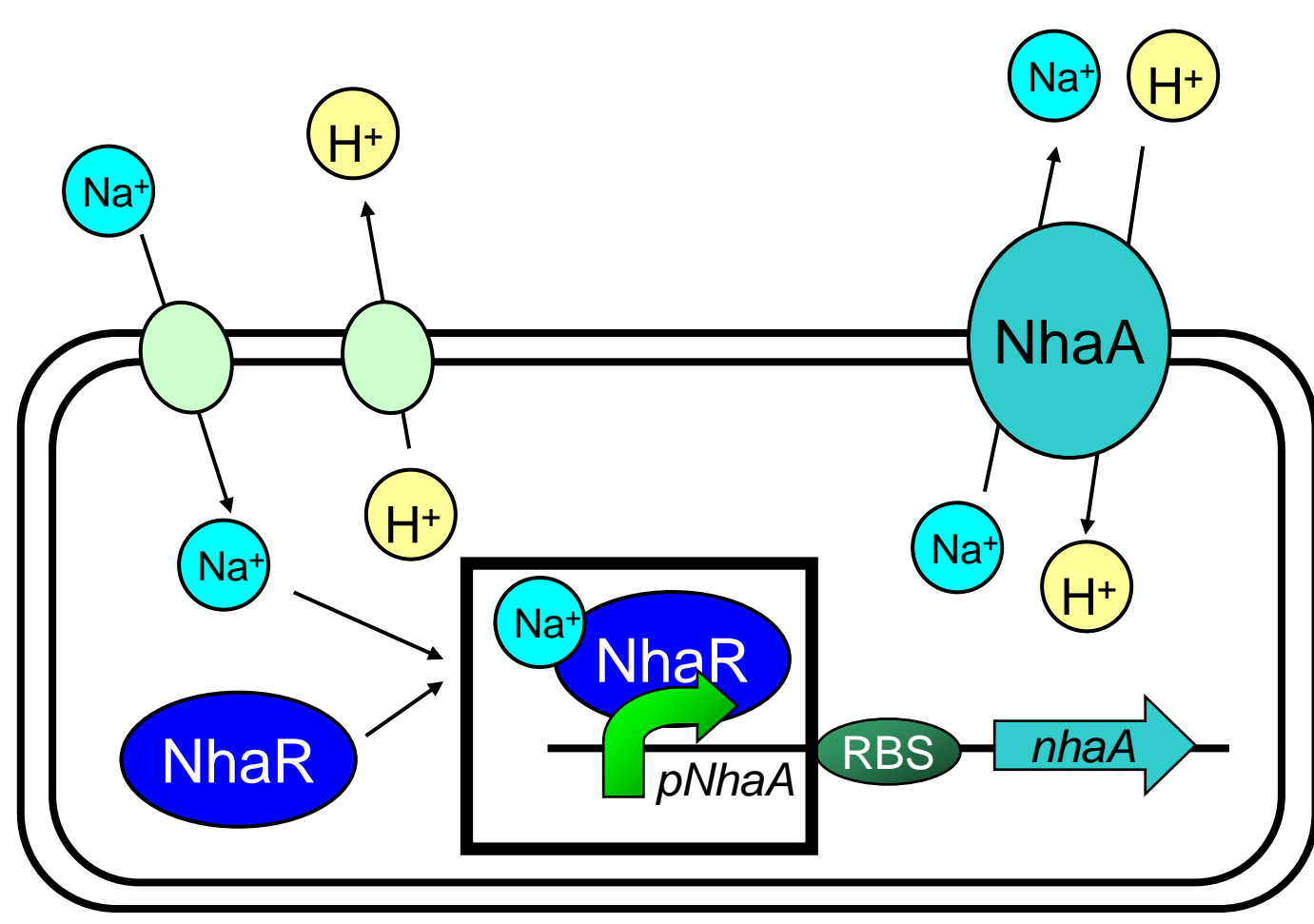
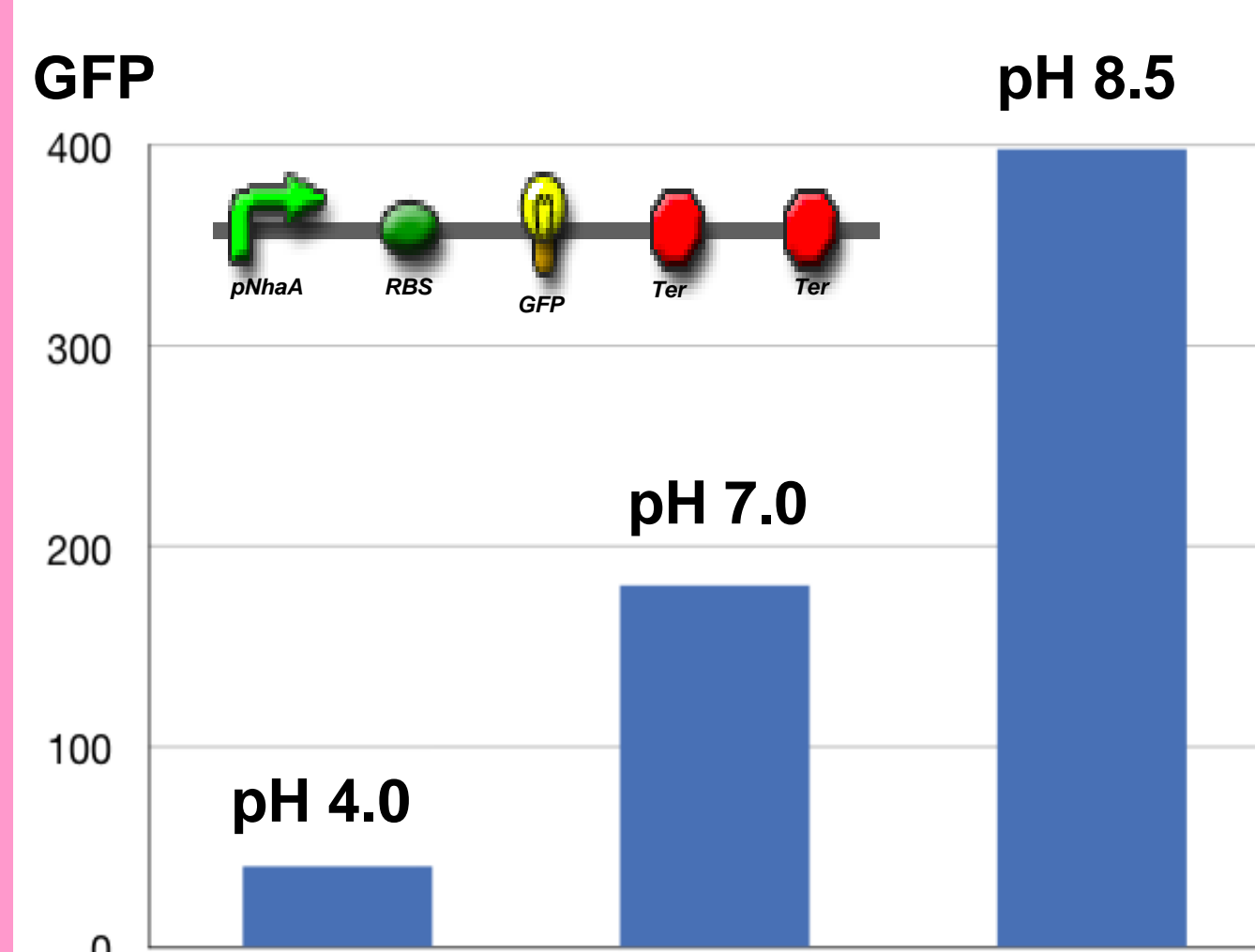
Low phosphate condition can be detected in time  
Removal efficiency 3.84 ~ 12.80 pmol/cell

## pH sensor

Senses high pH condition in the intestine lumen and starts gene expression.

**High pH sensing promoter—pNhaA:**

- NhaA: H<sup>+</sup> - Na<sup>+</sup> anti-transporter of *E. coli*
- NhaR: Na<sup>+</sup> binding protein, which can activates pNhaA
- pNhaA: high pH sensing promoter.



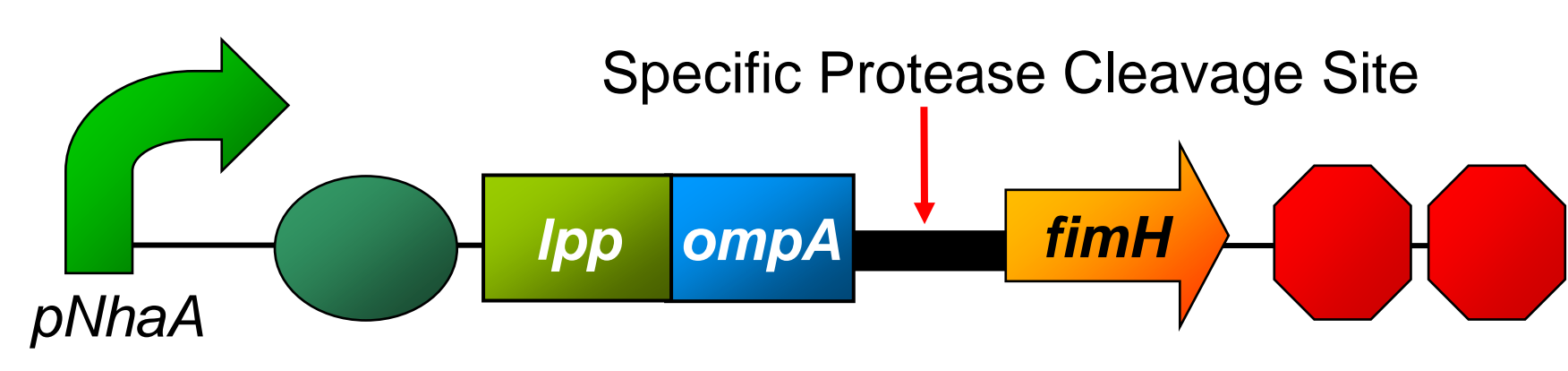
High pH condition can be detected in 3.5 hours

## Attachment & Detachment

- BacToKidney can attach to enhance waste removal
- BacToKidney can detach after a specified time units

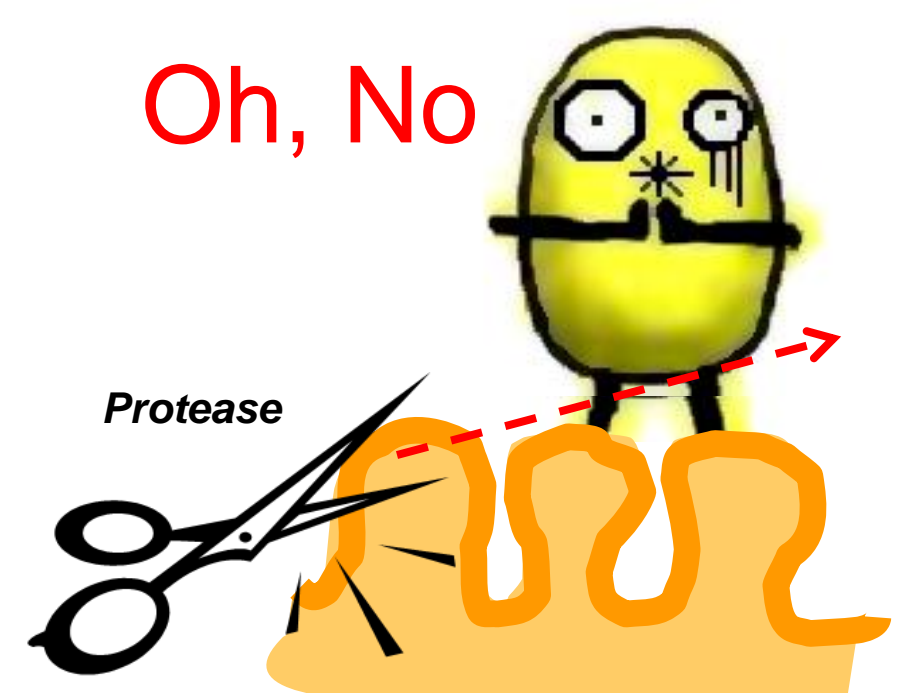
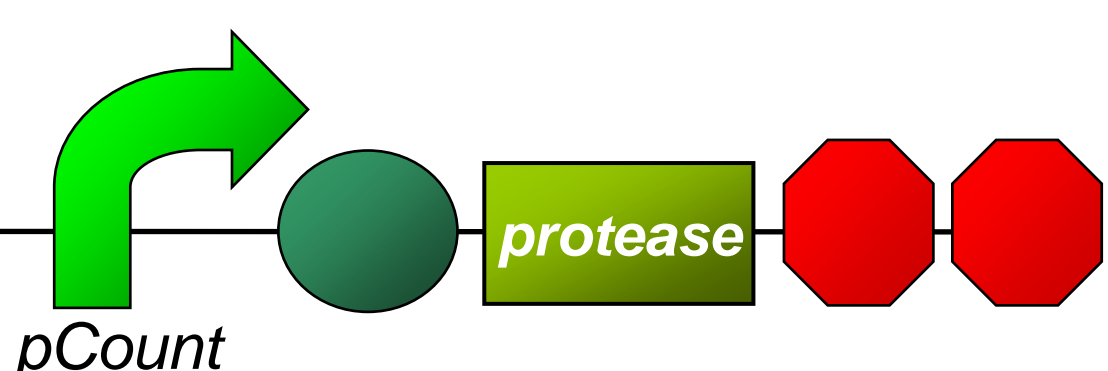
**Attachment:**

- Lpp: membrane guiding signal peptide
- OmpA: transmembrane domain
- FimH: attaching domain to anchor on the intestinal epithelial cell surface



**Detachment:**

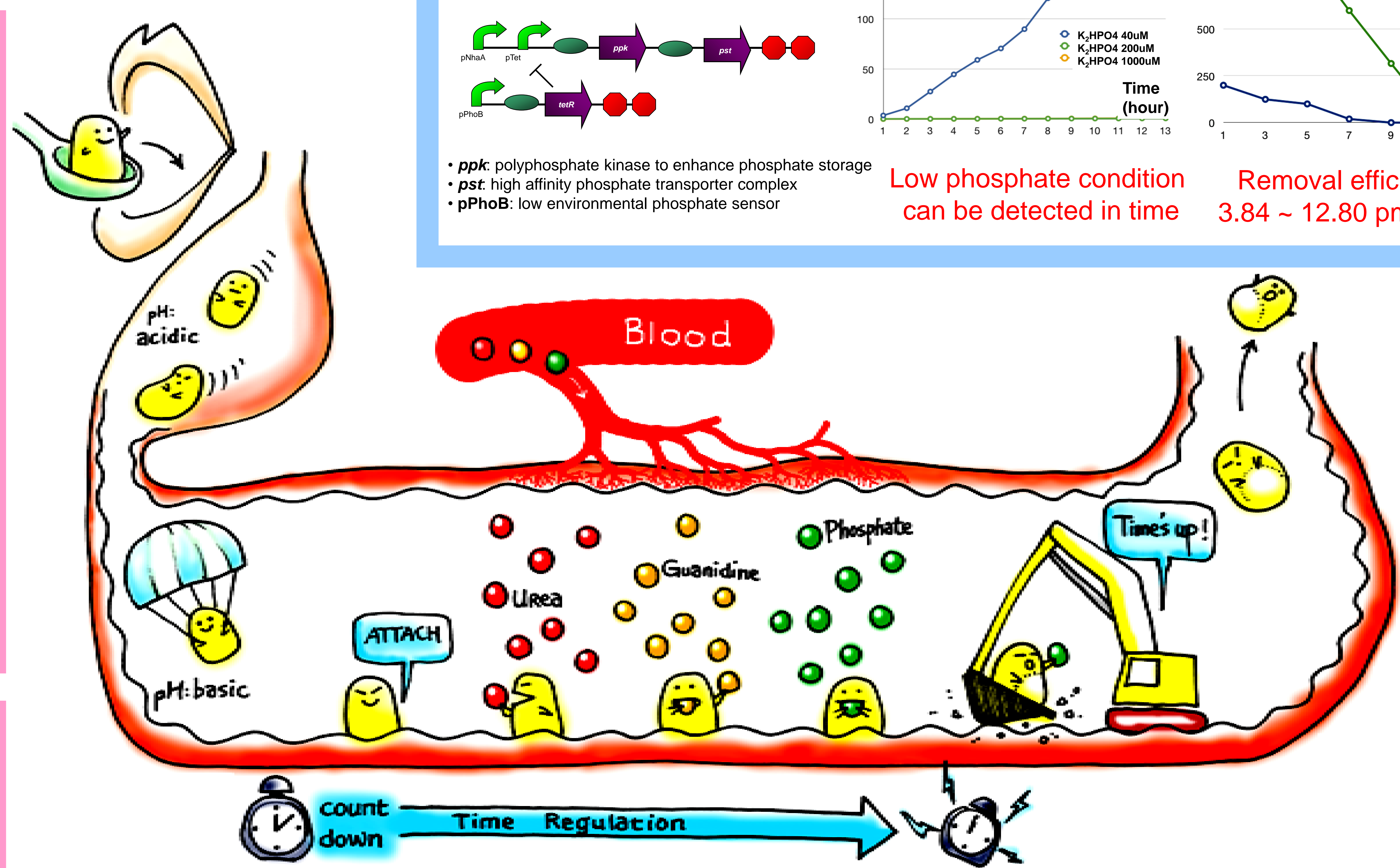
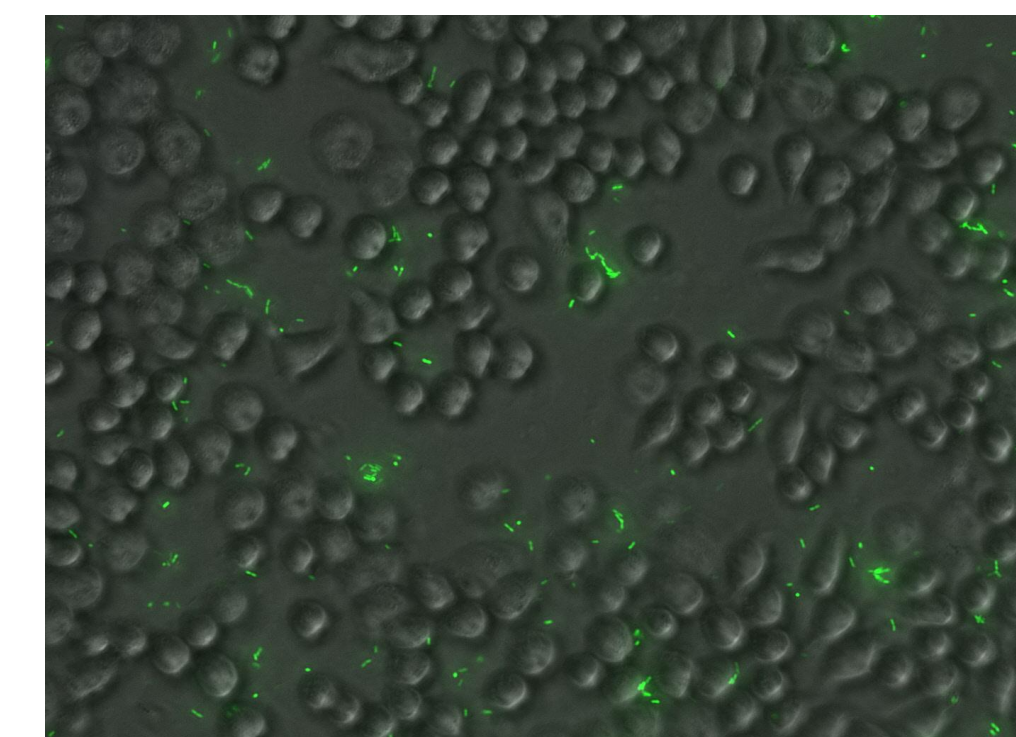
A time-regulated protease is expressed to cleave the site between the OmpA and FimH protein domains.



**Characterization:**

Bacteria and HT-29 cells were co-culture for 2 hours and washed by PBS to calculate the amount of attached bacteria

Localization of *E. Coli* Chassis in Attachment Assay

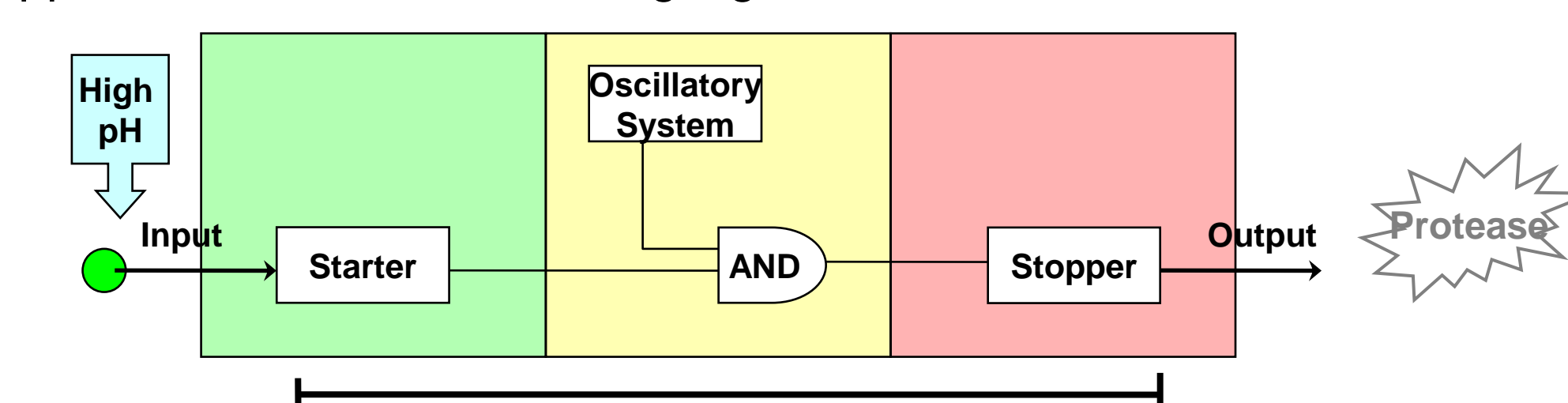


## Time Regulation

- BacToKidney can detach after specified time units
- Modularized timer configuration

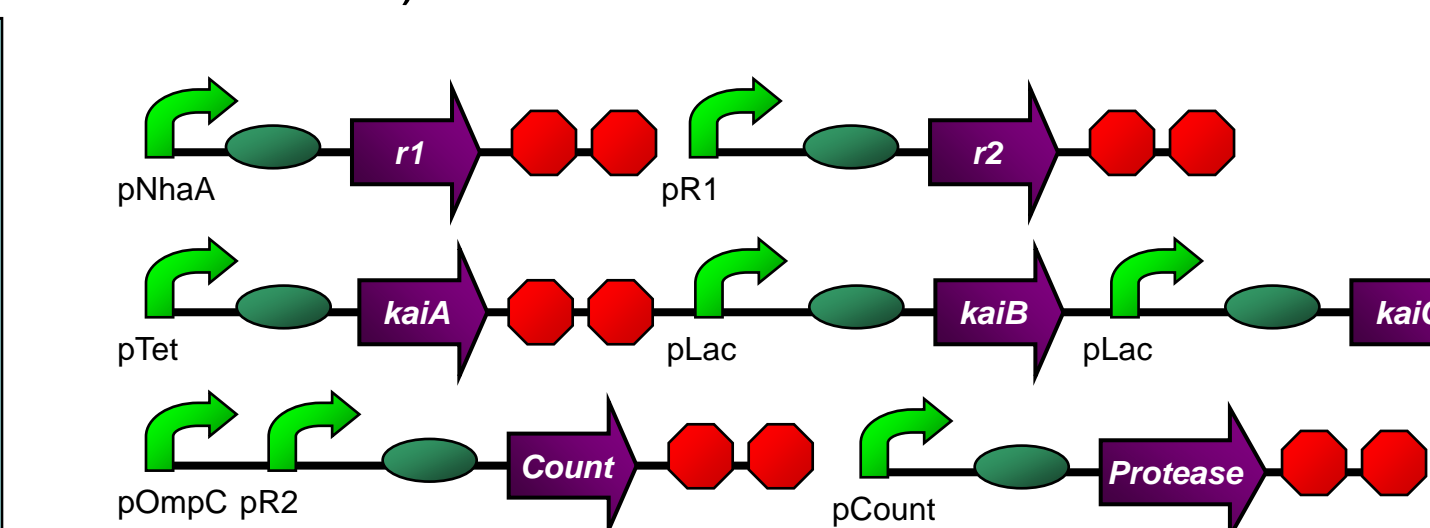
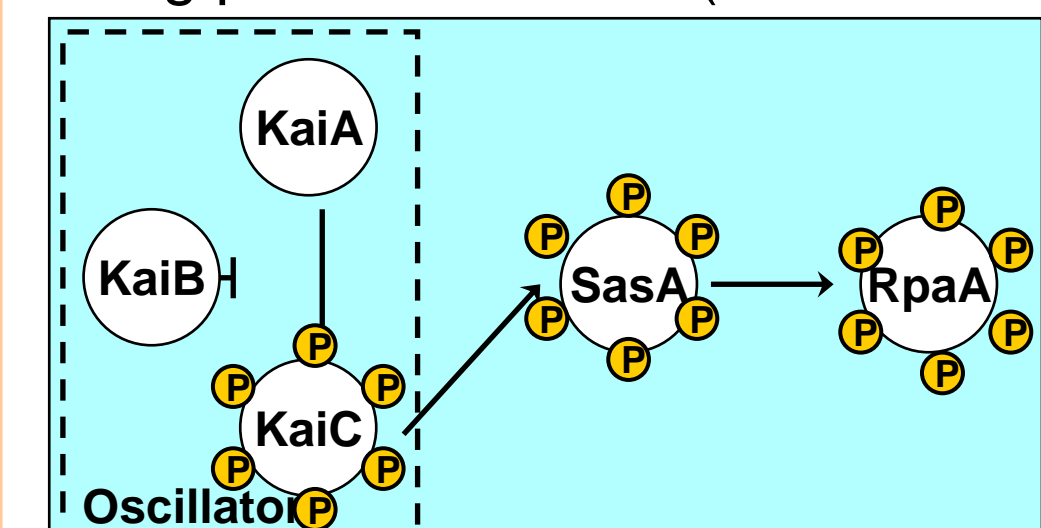
**Modules in The Timer:**

- Starter: Starts to count
- Oscillatory System: Defines the time unit of Timer
- Stopper: Produces a Terminating signal



**The Cyanoxilator (cyanobacterial oscillator):**

Long period Oscillator (between 14 and 60 hours)



**The Reloxilator (relaxation oscillator):**

- A tuneable, synchronized, cellular relaxation oscillator.
- A combination of parts from  $\lambda$  phage *V. Fischeri*, and *E. coli*.
- Has a period of around 46 minutes.

