

ACT Science Practice Paper

Use this passage to answer the next 7 questions:

The bacterial strain SN2 (*Alteromonas naphthalenivorans*) is known to contaminate both tidal flats and seawater. The graphs in Figure 1 show the results of an experiment intended to measure the cell growth of SN2 in a tidal flat environment with added Naphthalene (TF-N) and a tidal flat environment with added Pyruvate (TF-P). The concentration of Naphthalene and Pyruvate were also measured within this experiment. Additionally, changes in the optical density of seawater was measured when both Naphthalene and Pyruvate were added. The goal of this experiment was to better understand the Eco physiological behavior of SN2 in contaminated environments. The graphs in Figure 2 depict levels of correlation in level of gene expression between conditions.

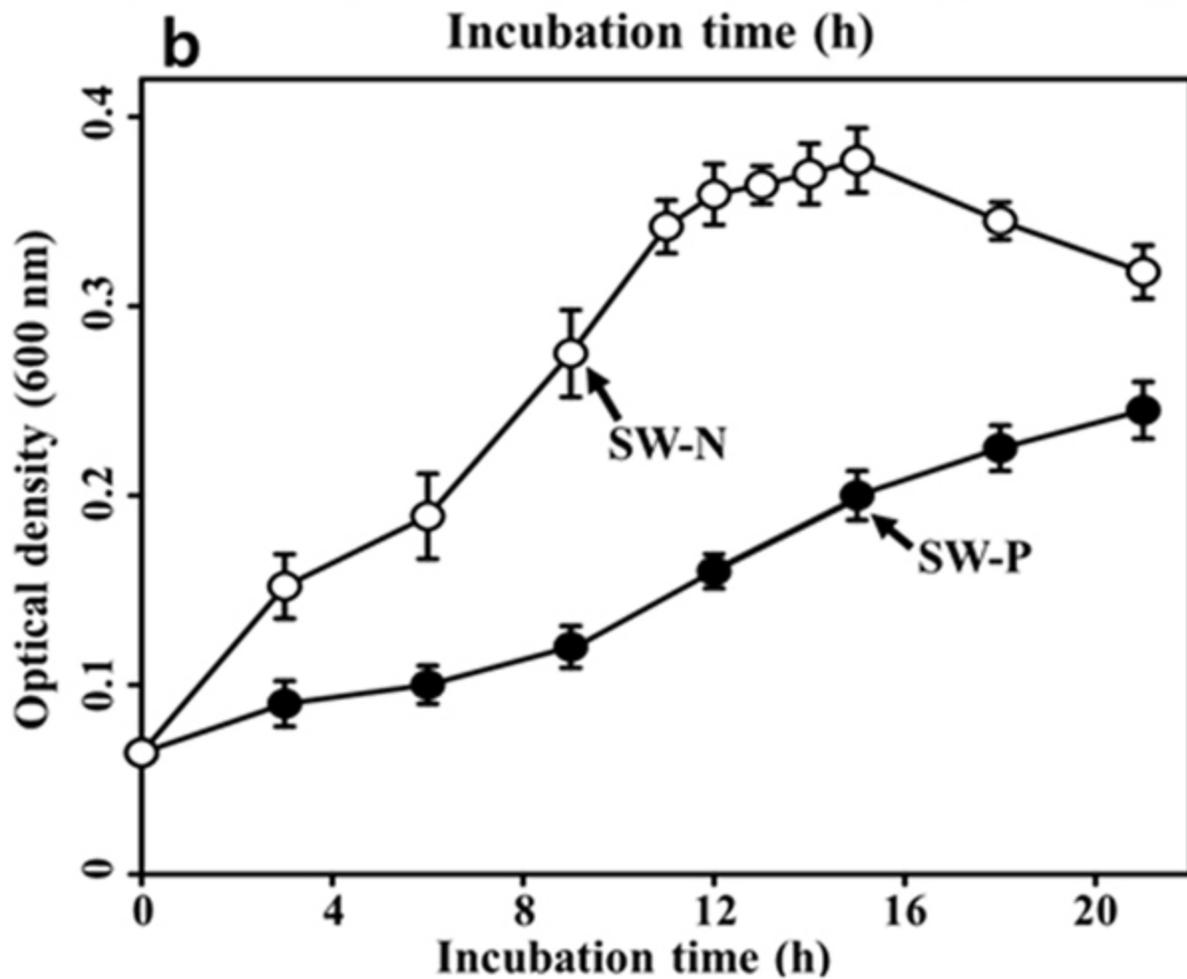
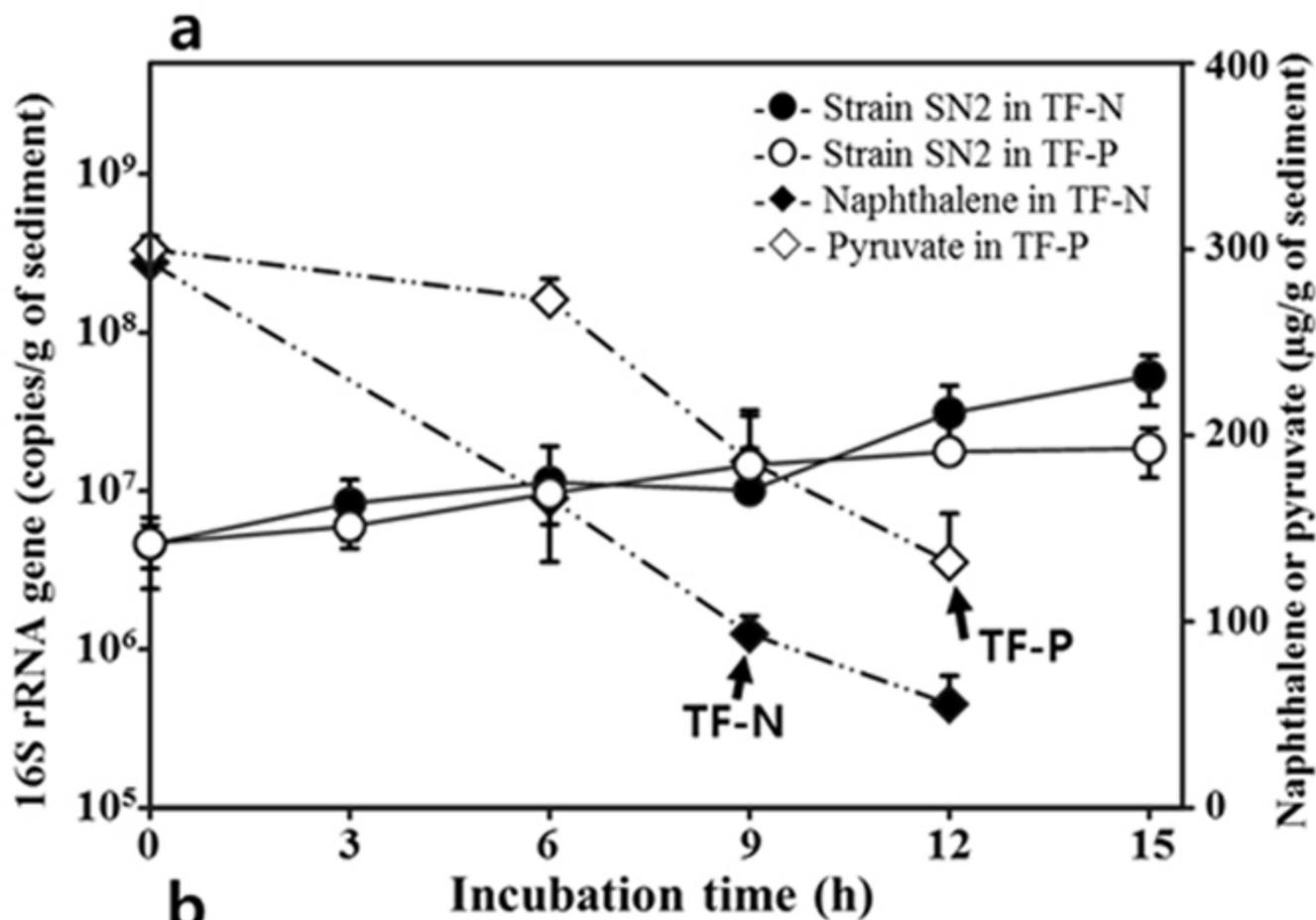


Figure 1

Log₂-based RPKM values

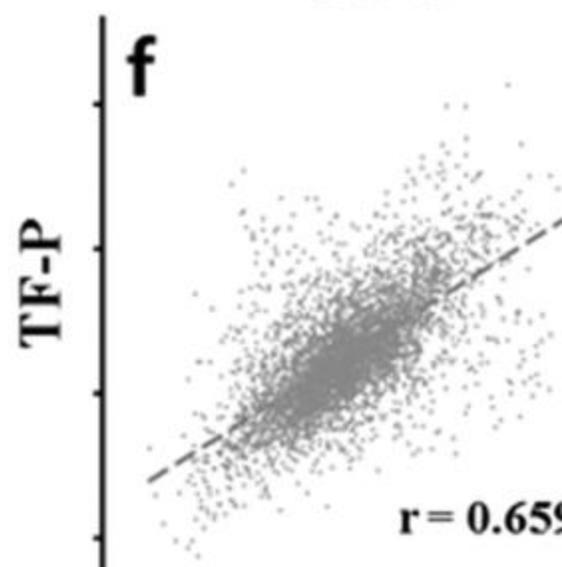
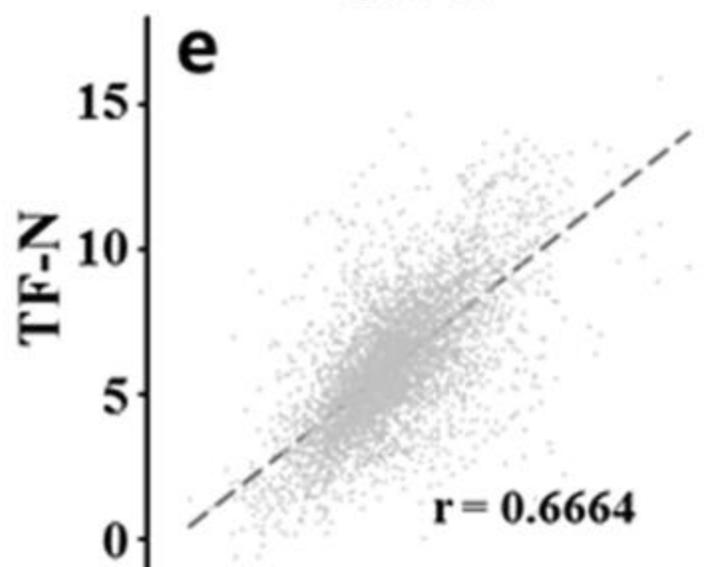
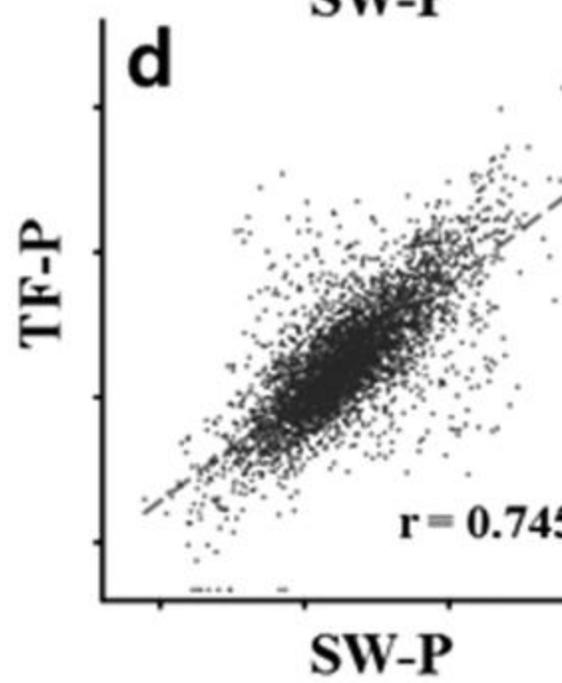
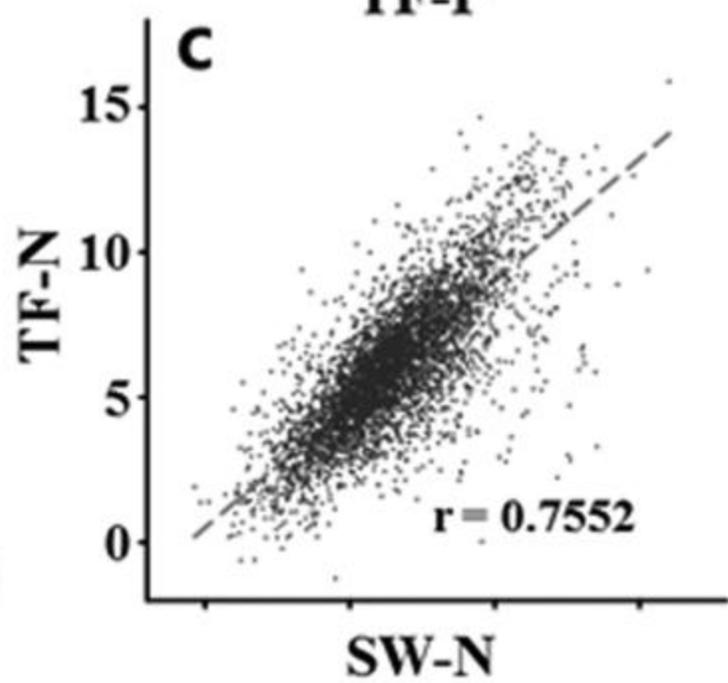
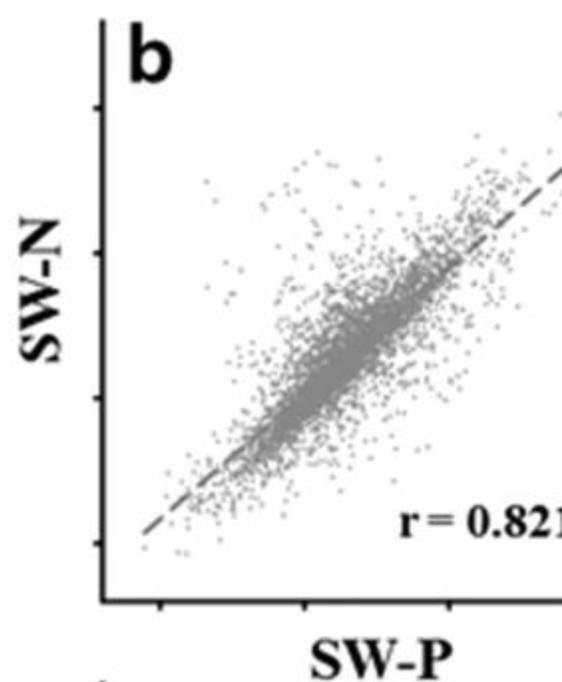
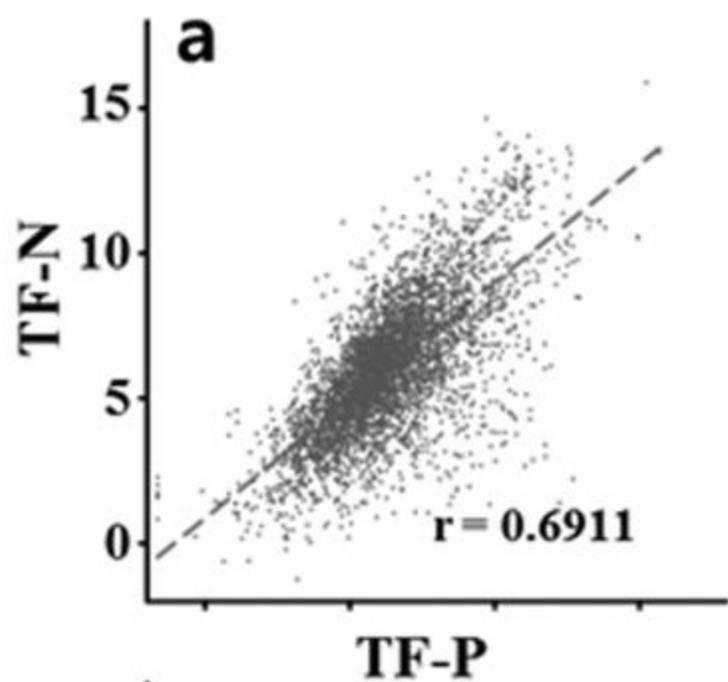


Figure 2

Figures adapted from *Genome-wide transcriptional responses of Alteromonas naphthalenivorans SN2 to contaminated seawater and marine tidal flat sediment* by Hyun mi Jin et al.

1. In Figure 1, what is the relationship between Pyruvate concentration and Naphthalene concentration?

- As Pyruvate decreases, Naphthalene increases.
- As one decreases, the other does as well.
- As Pyruvate increases, Naphthalene decreases.
- There is no clear relationship between concentrations of Pyruvate and Naphthalene in Figure

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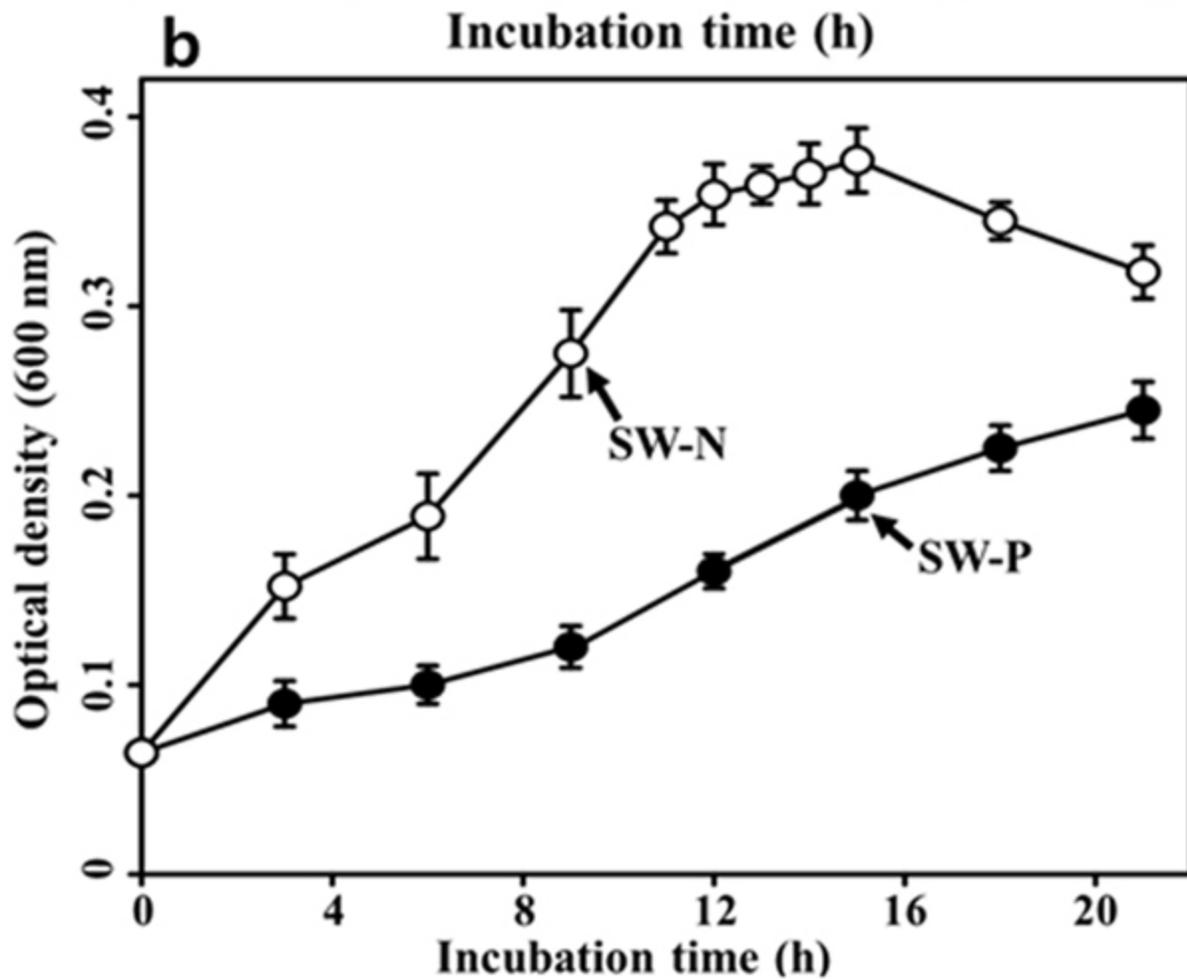
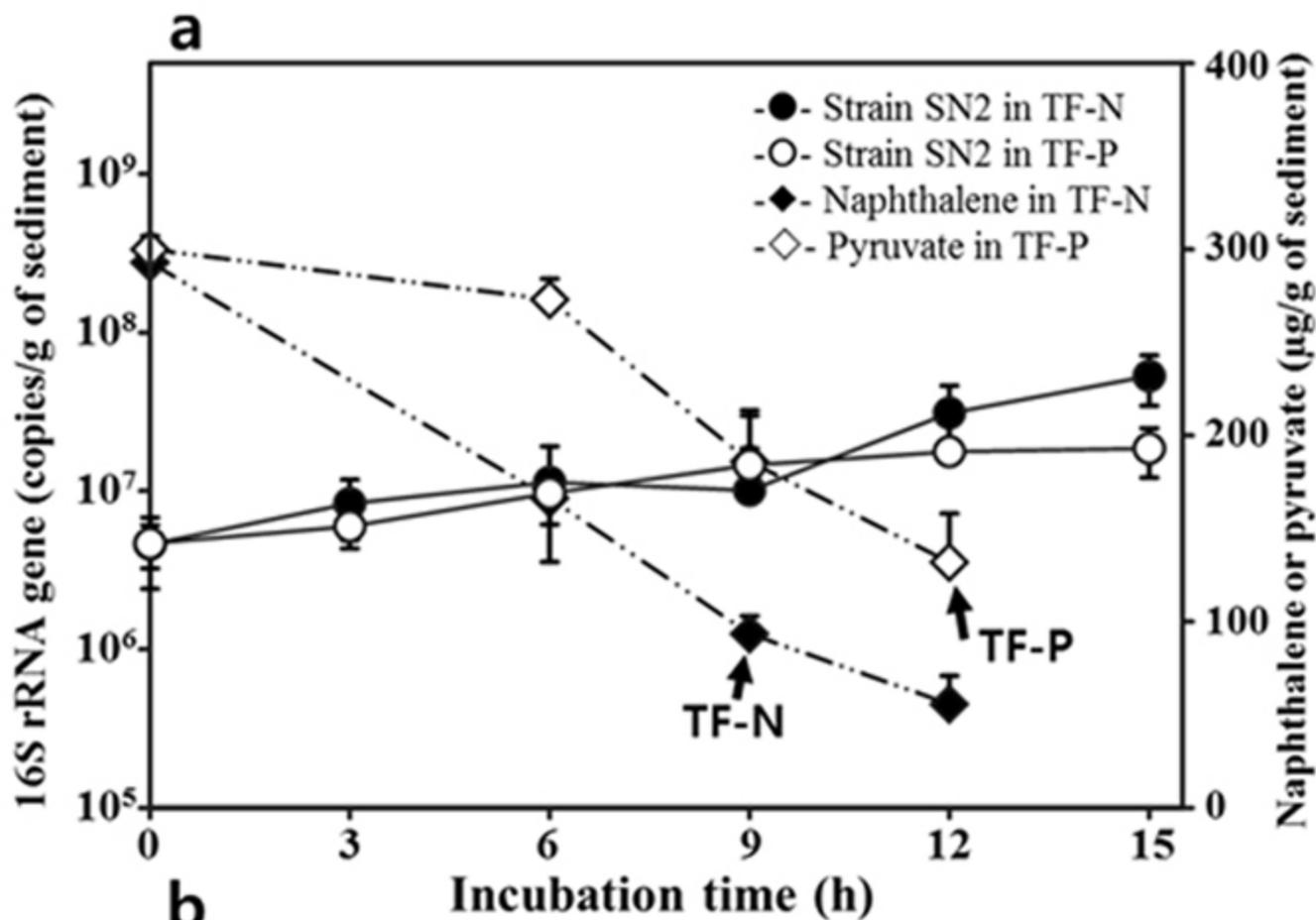


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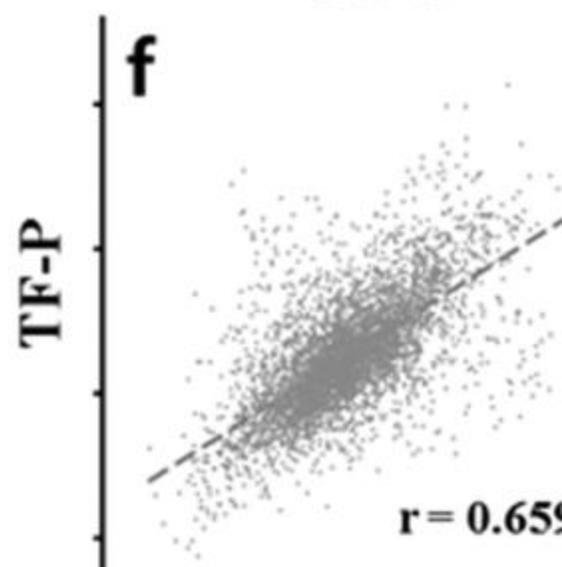
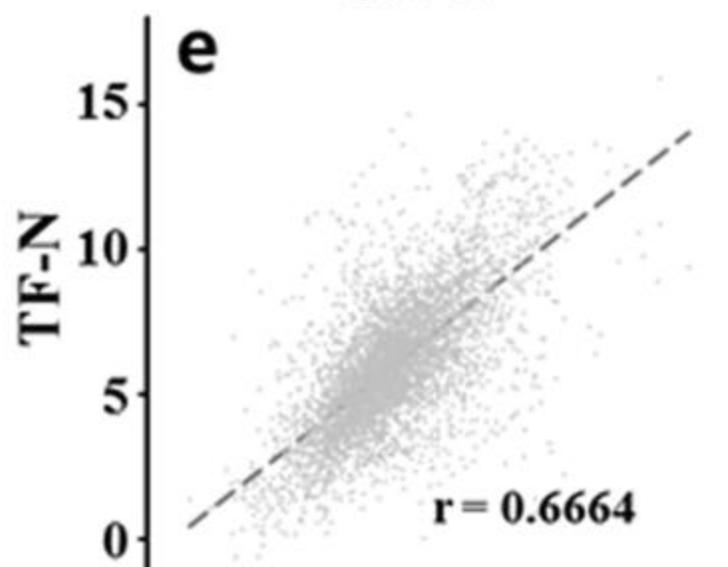
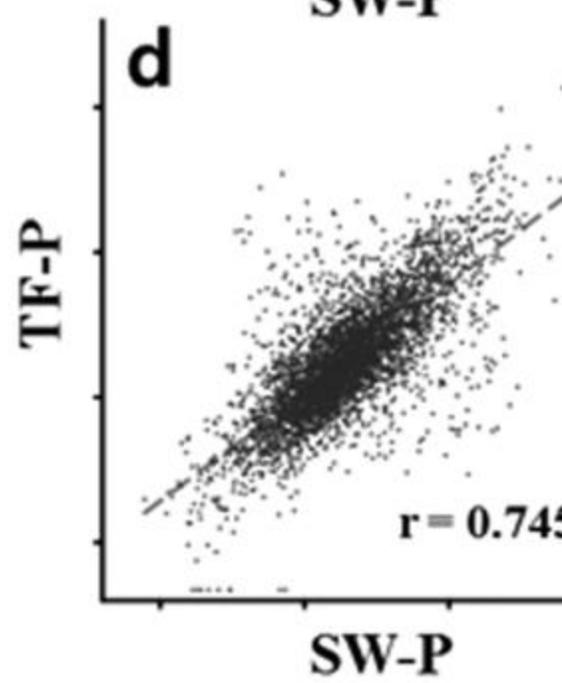
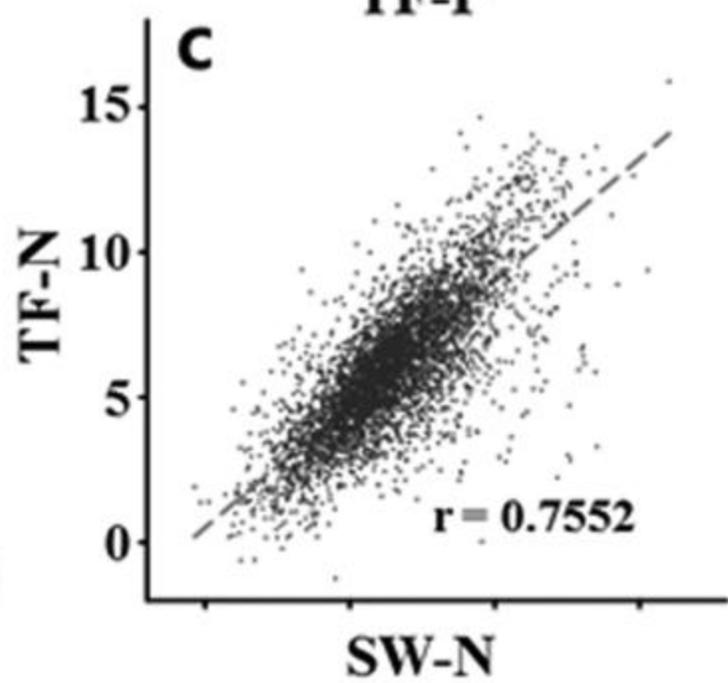
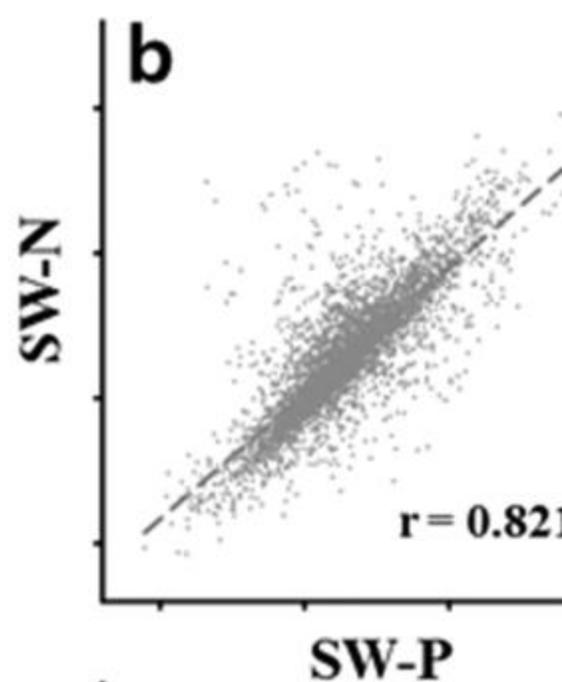
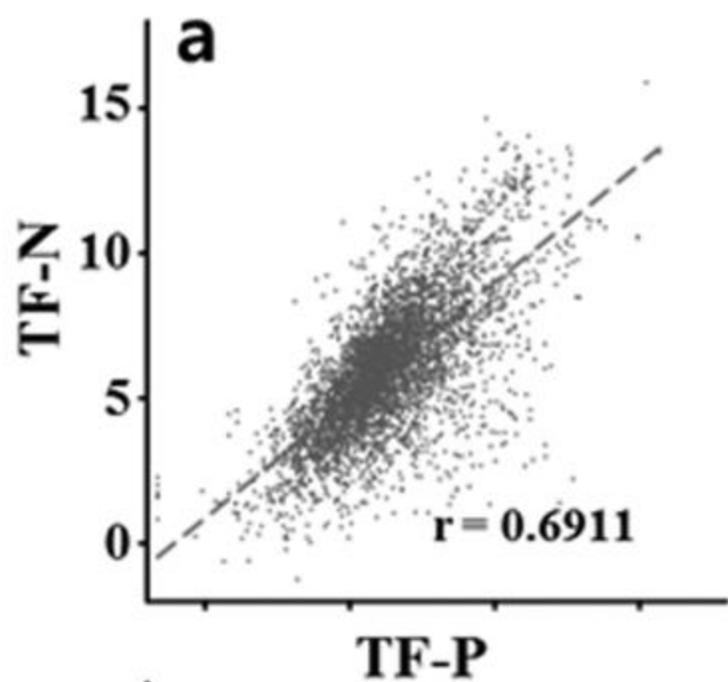


Figure 2

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2. After 12 hours of incubation, how many copies/g of sediment of the 16S rRNA gene are there of the SN2 strain in the TF-N condition?

- A. Greater than 10^8
- B. Between 10^6 and 10^7
- C. Between 10^7 and 10^8
- D. Less than 10^6

- A
- B
- C
- D

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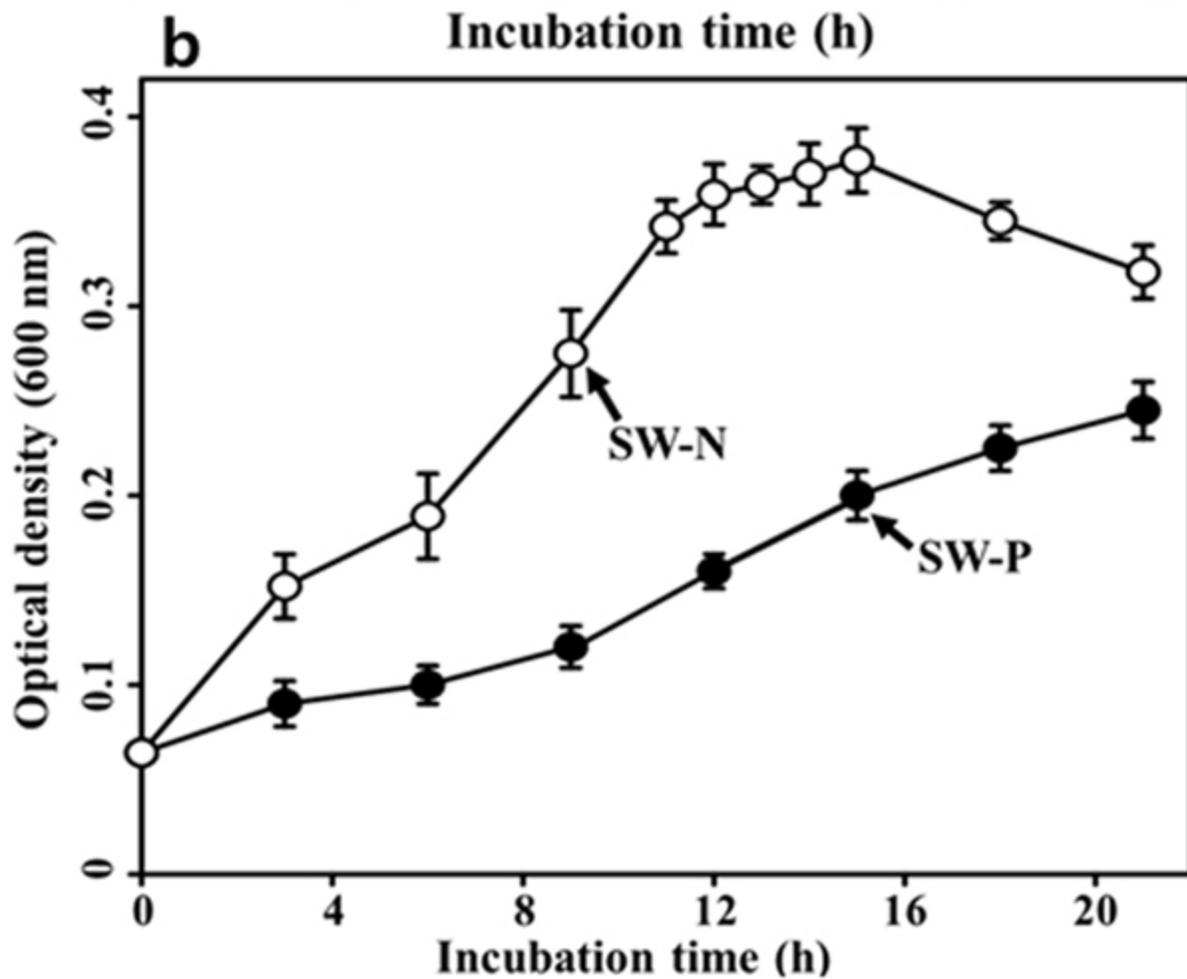
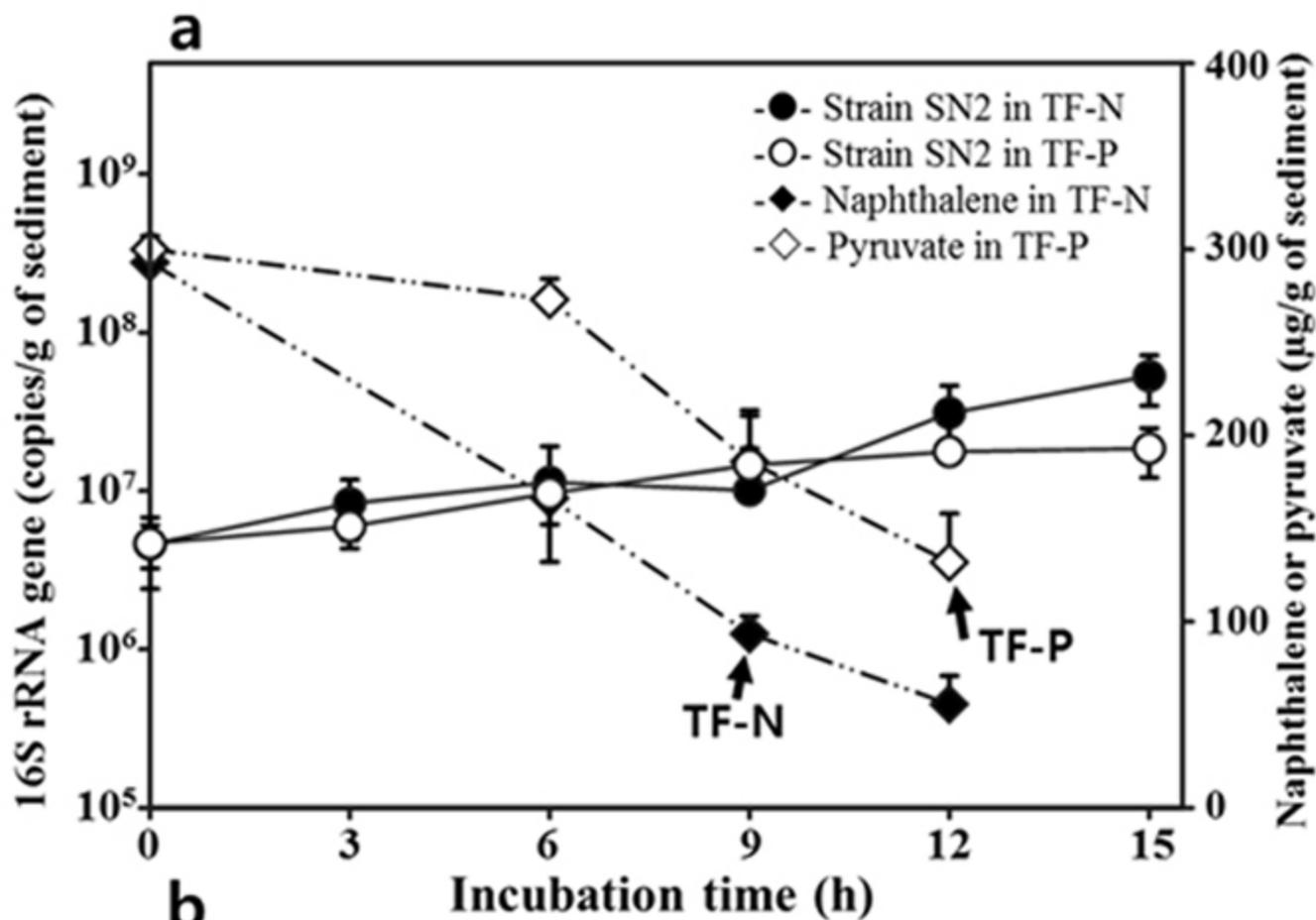


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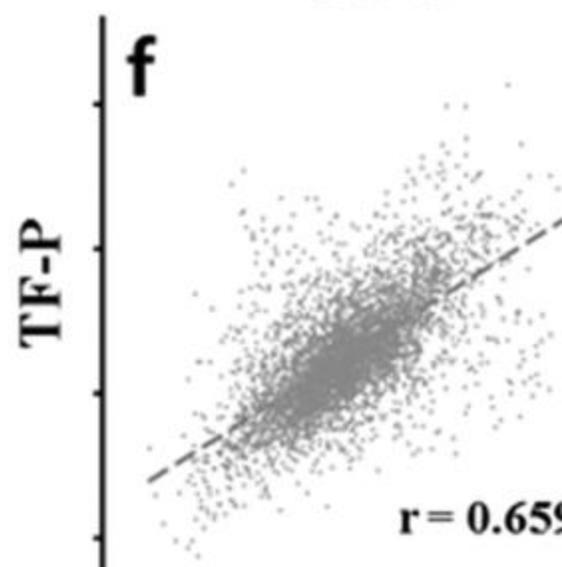
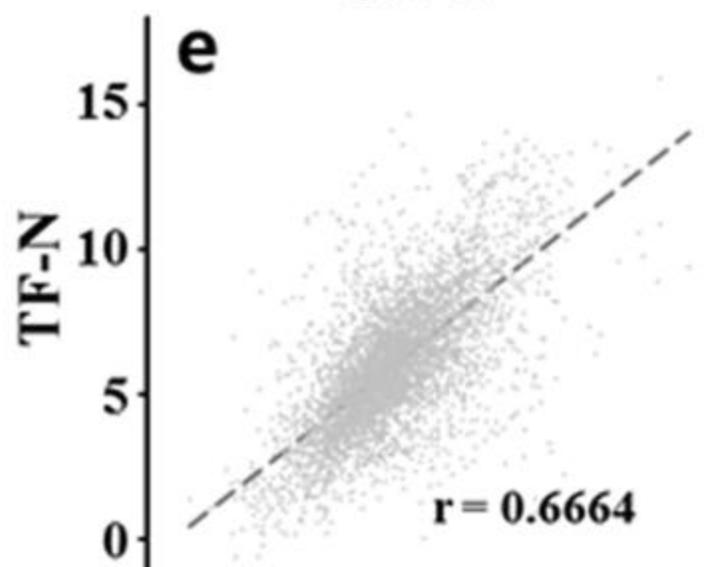
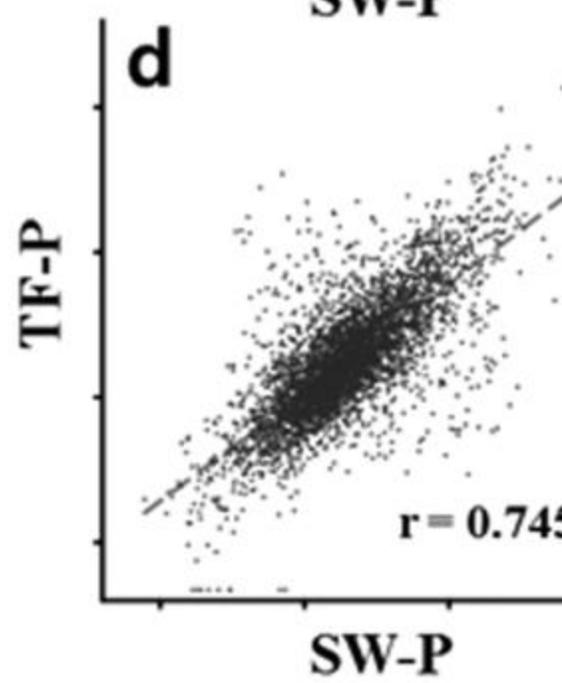
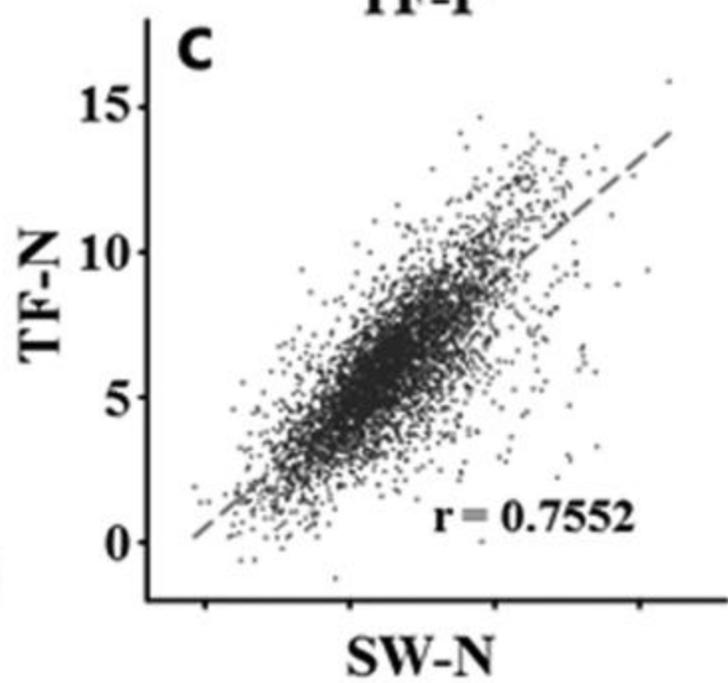
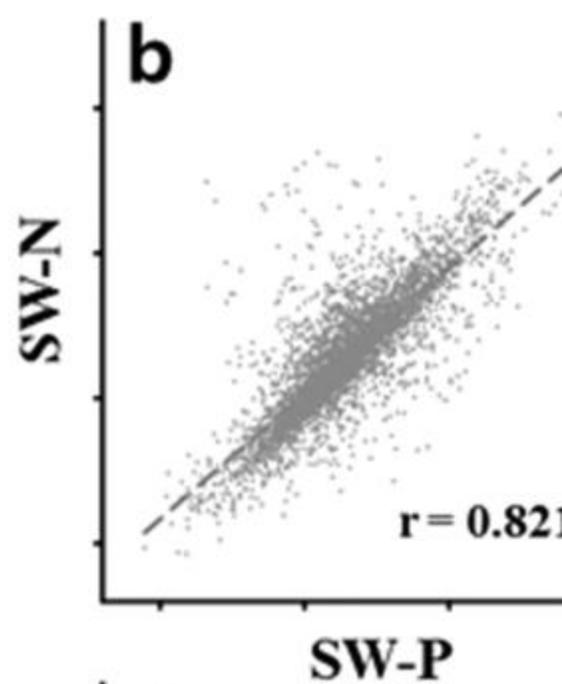
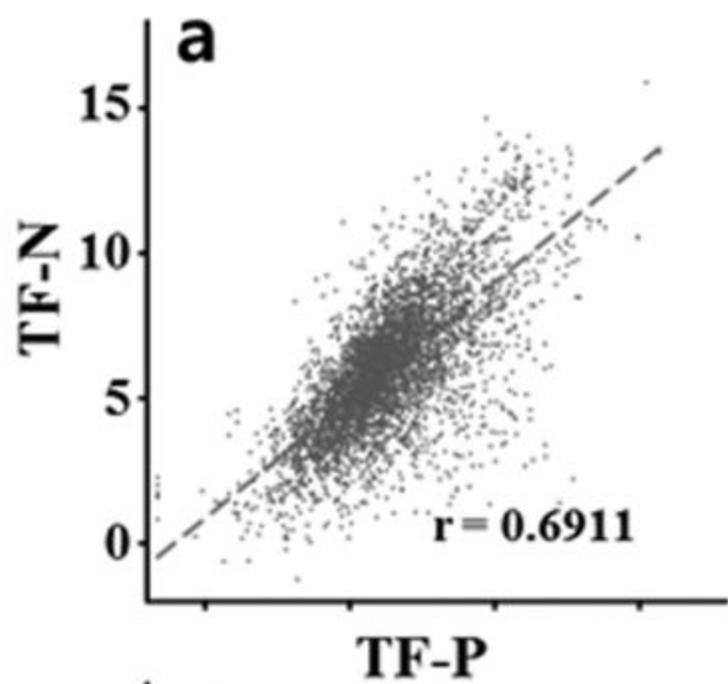


Figure 2

Figures adapted from *Genome-wide transcriptional responses of Alteromonas naphthalenivorans SN2 to contaminated seawater and marine tidal flat sediment* by Hyun mi Jin et al.

3. In Figure 1, what is the relationship between Pyruvate concentration and strain SN2 in TF-P?

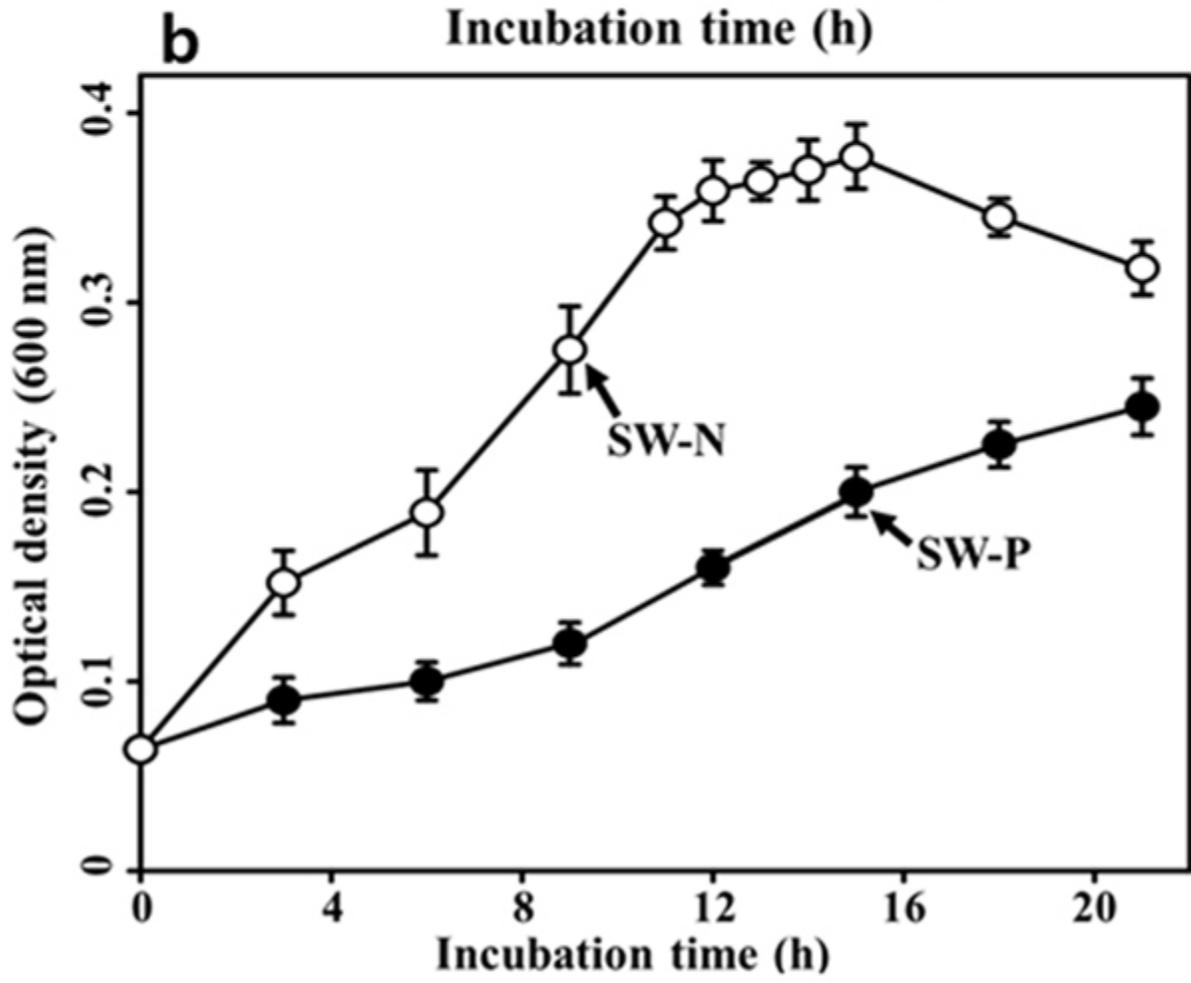
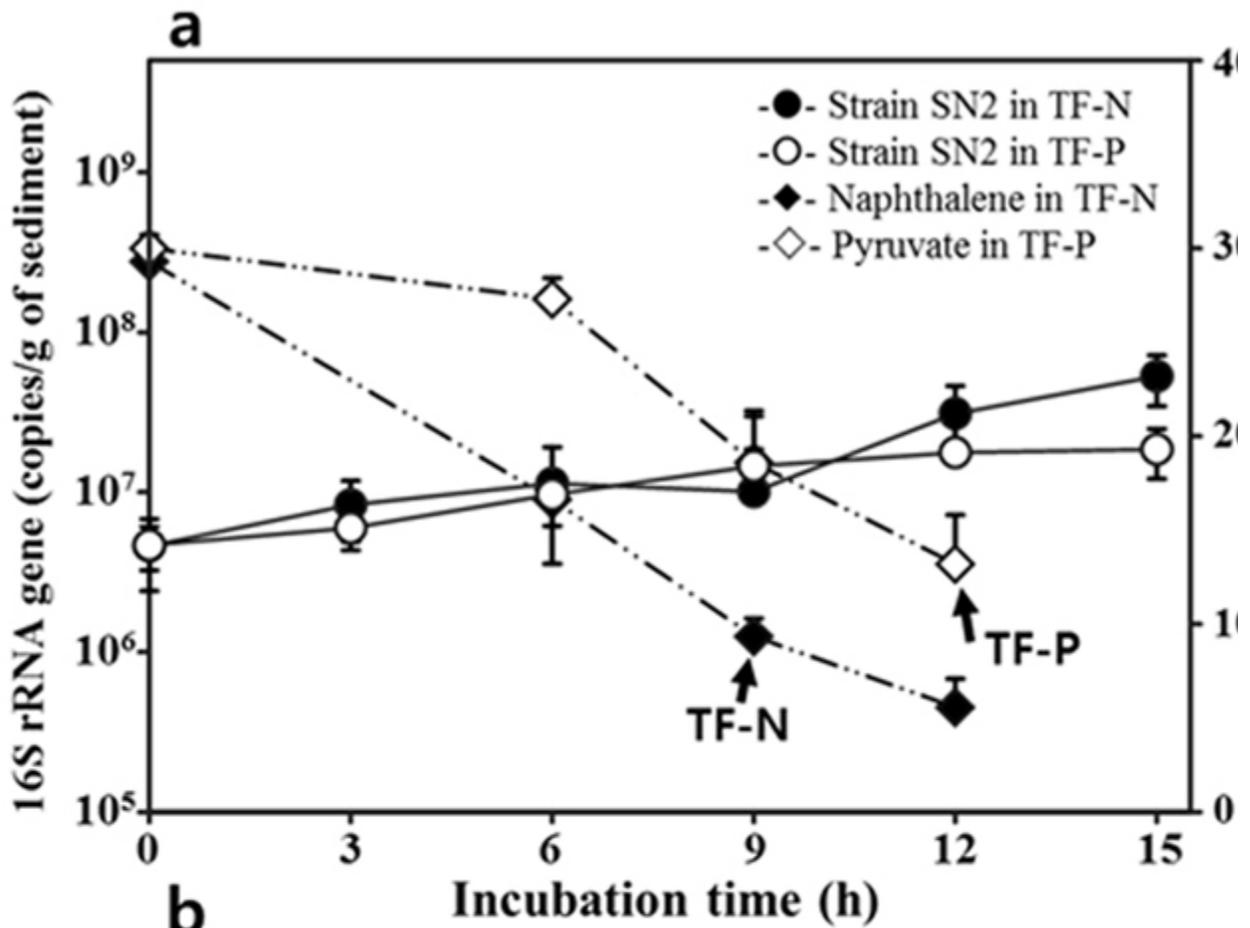
- As one decreases, the other increases.
- As one decreases, the other does as well.
- As one increases, the other does as well.
- There is no clear relationship between concentrations in Figure 1.

ACT Science Quiz 3

Data Representation (4 of 7)

The bacterial strain SN2 (*Alteromonas naphthalenivorans*) is known to contaminate both tidal flats and seawater. The graphs in Figure 1 show the results of an experiment intended to measure the cell growth of SN2 in a tidal flat environment with added Naphthalene (TF-N) and a tidal flat environment with added Pyruvate (TF-P). The concentration of Naphthalene and Pyruvate were also measured within this experiment. Additionally, changes in the optical density of seawater was measured when both Naphthalene and Pyruvate were added. The goal of this experiment was to better understand the Eco physiological behavior of SN2 in contaminated environments. The graphs in Figure 2 depict levels of correlation in level of gene expression between conditions.

ACT Science Quiz 3



Figures adapted from *Genome-wide transcriptional responses of Alteromonas naphthalenivorans SN2 to contaminated seawater and marine tidal flat sediment* by Hyun mi Jin et al.

4. The highest optical density of the SW-N condition occurs closest to which incubation time?

- 0 hours
- 12 hours
- 16 hours
- 20 hours

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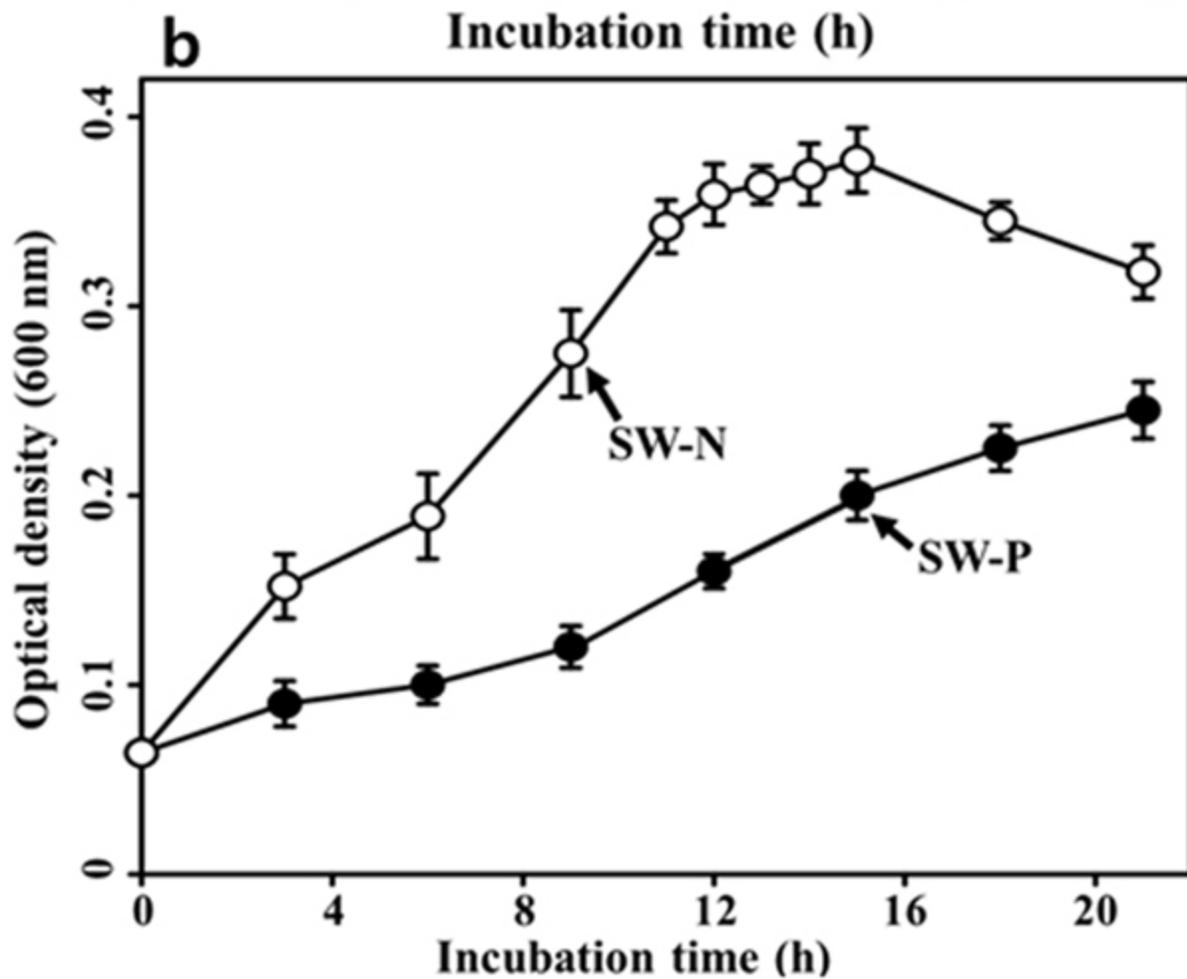
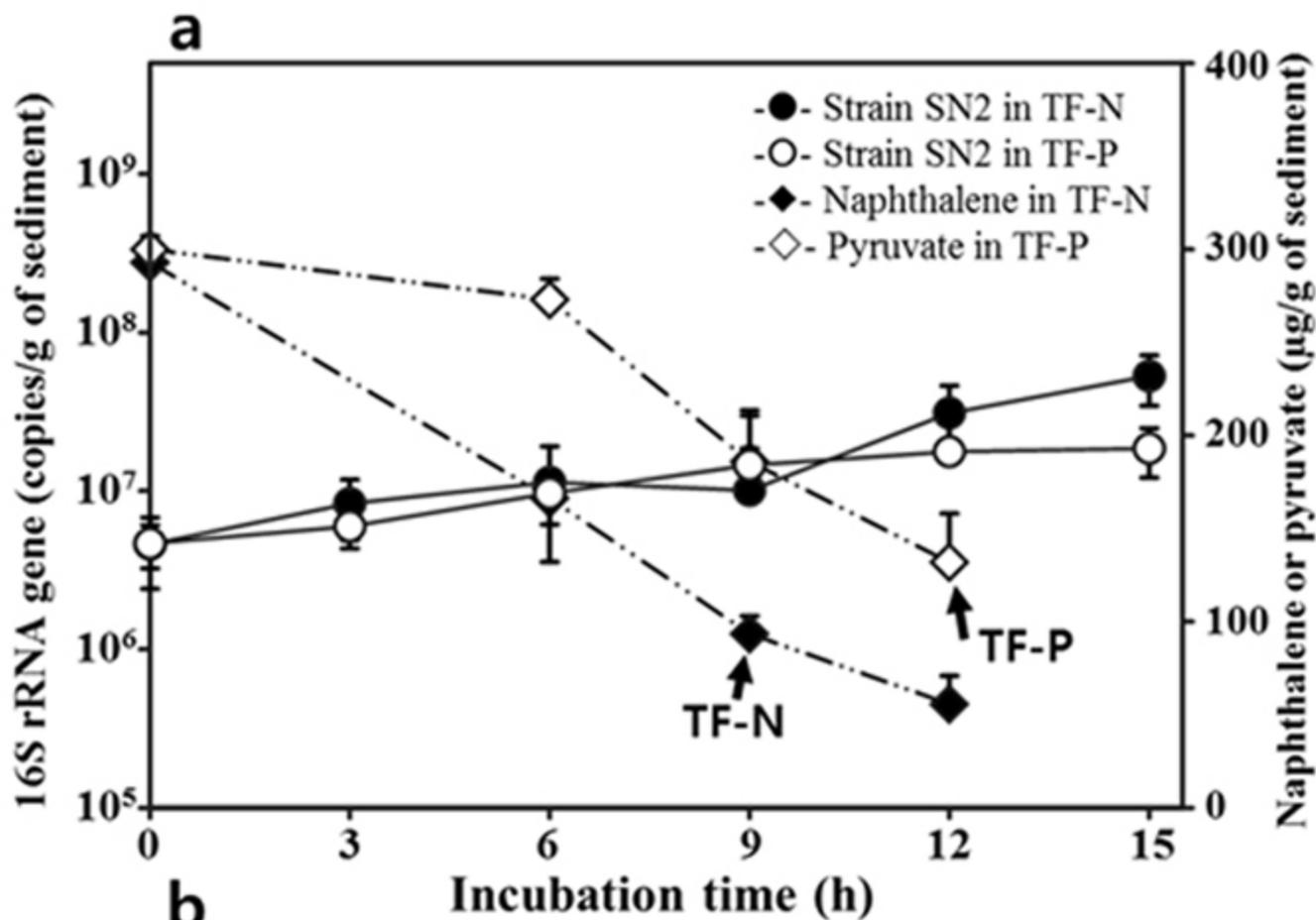


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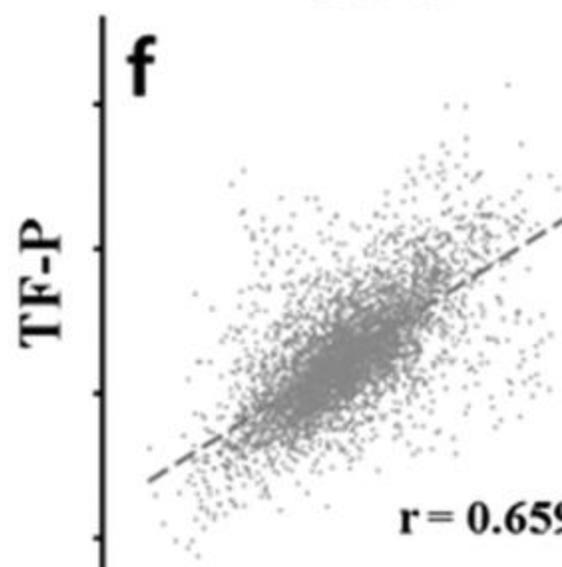
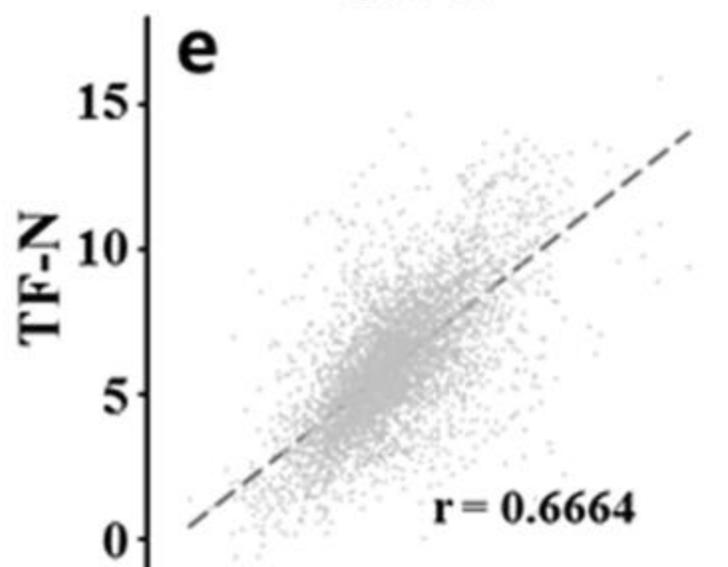
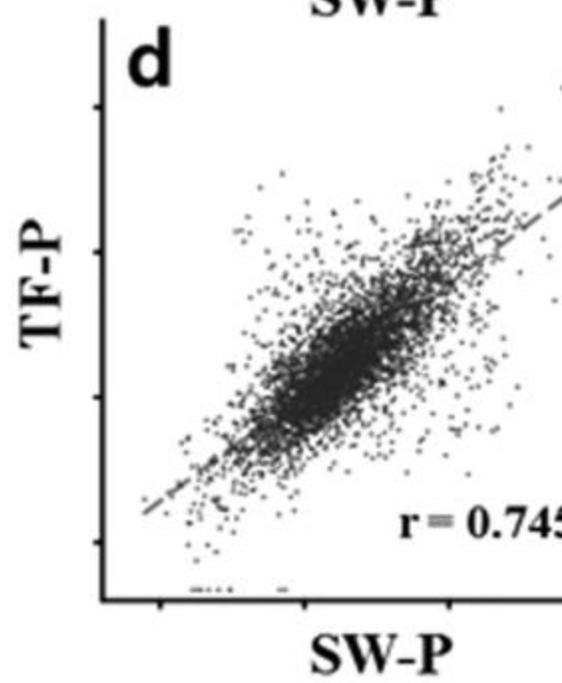
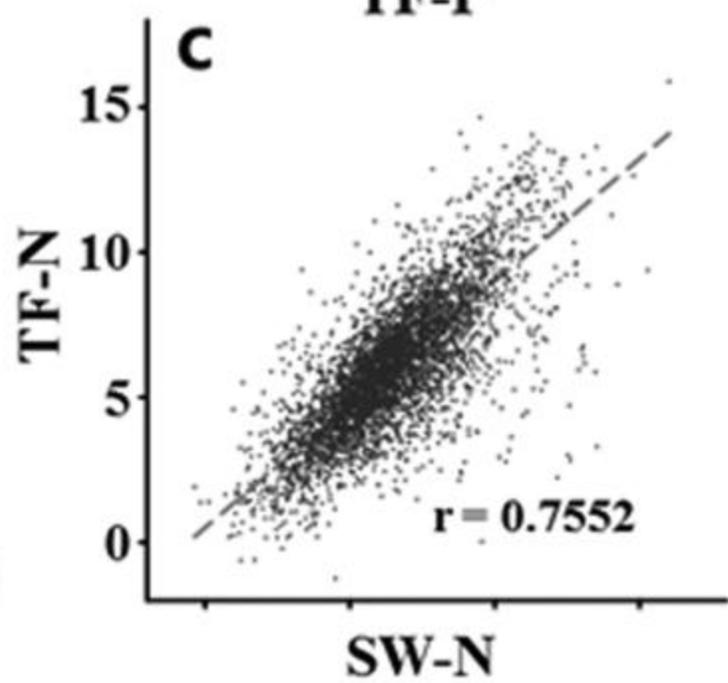
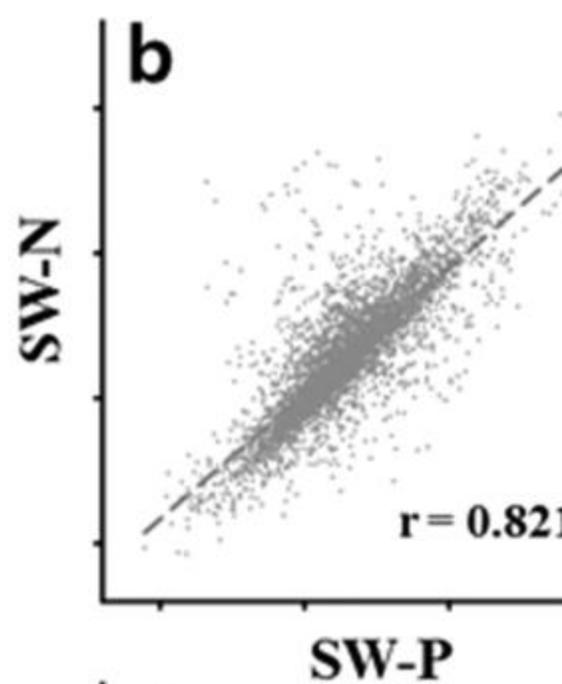
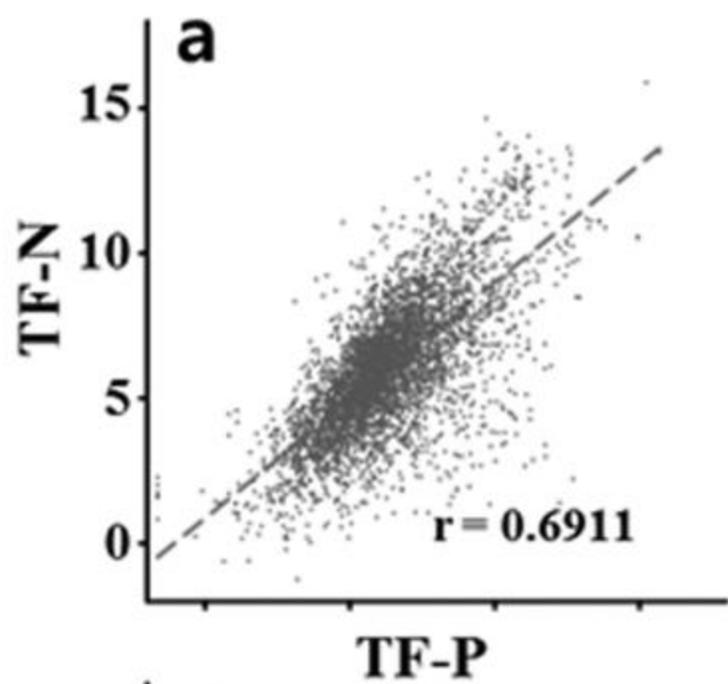


Figure 2

Figures adapted from *Genome-wide transcriptional responses of Alteromonas naphthalenivorans SN2 to contaminated seawater and marine tidal flat sediment* by Hyun mi Jin et al.

5. Which answer most closely represents the number of hours a decrease in optical density was observed during the seawater conditions?

- 0
- 4
- 16
- 20

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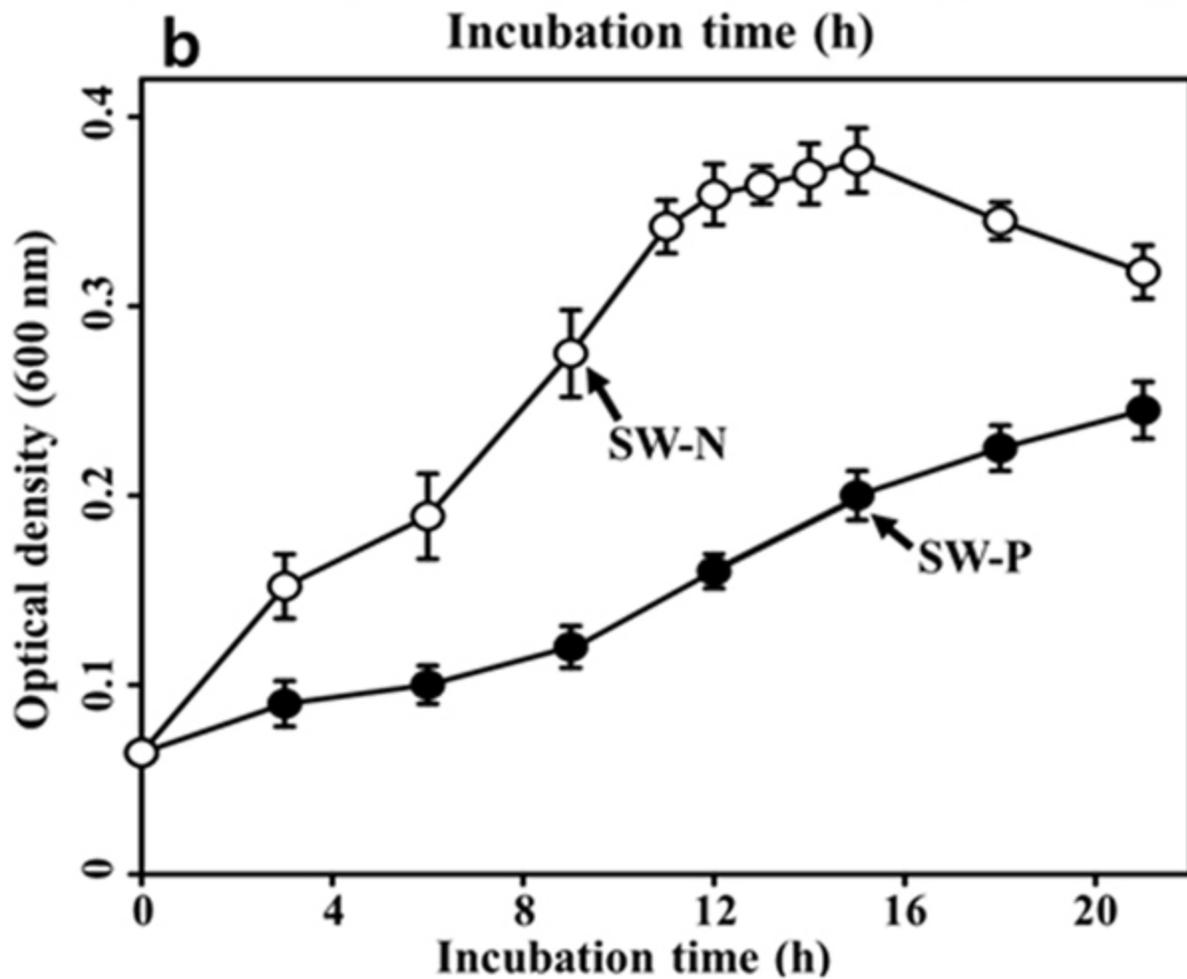
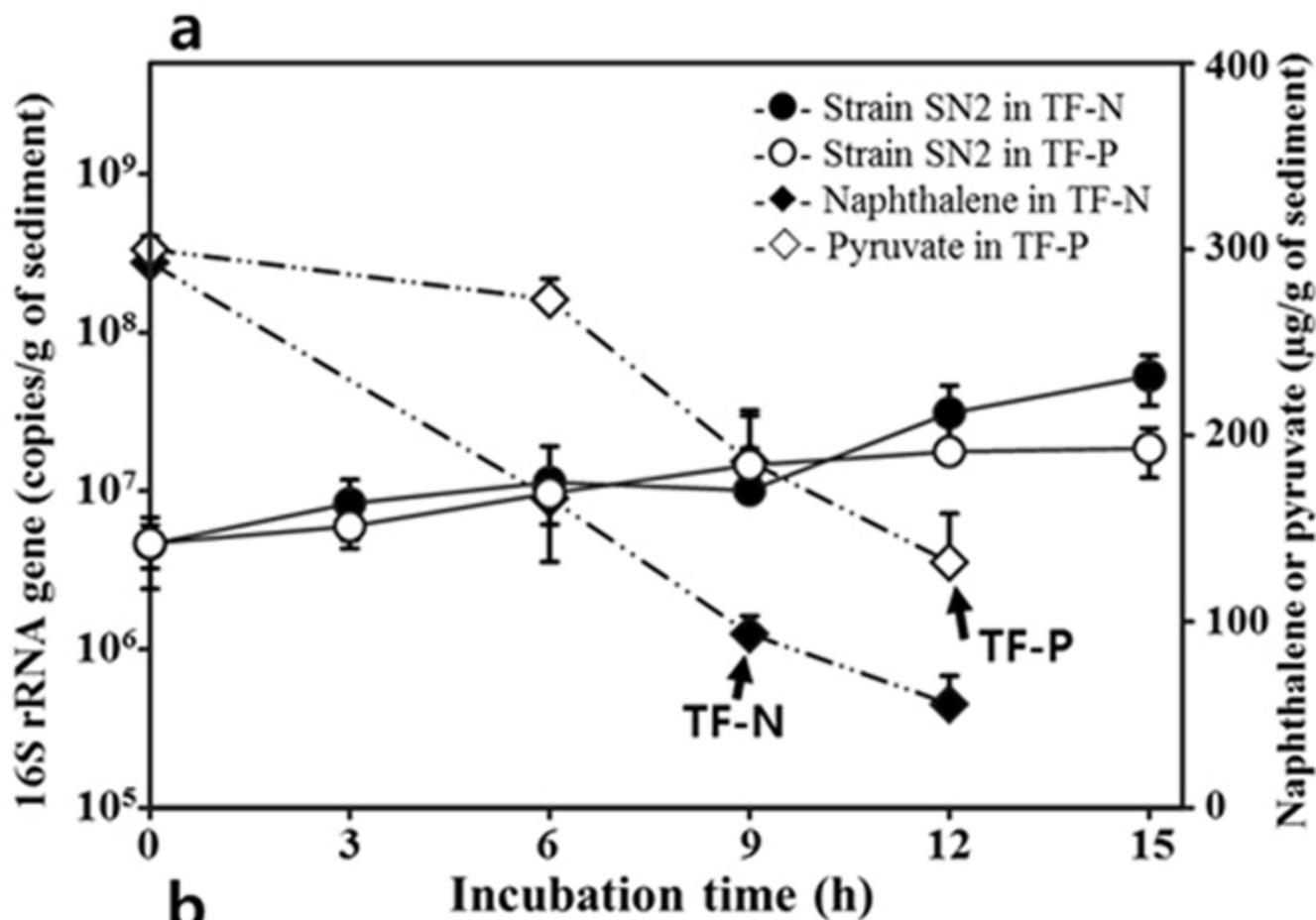


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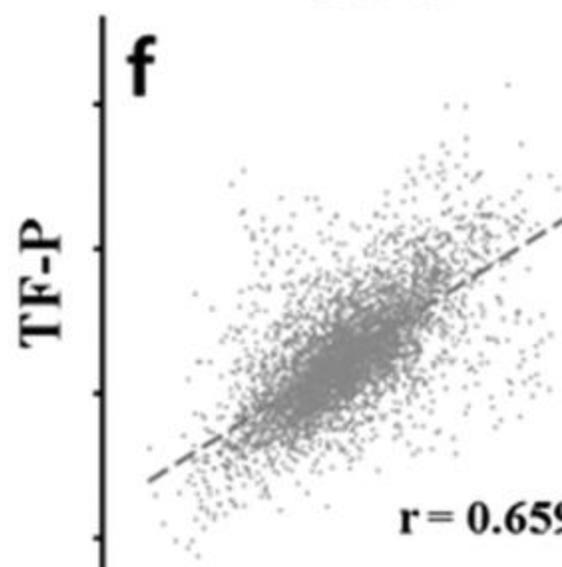
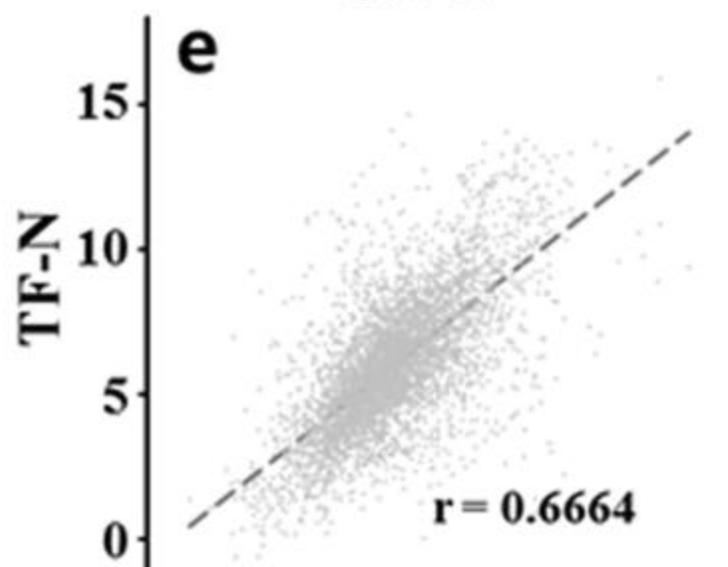
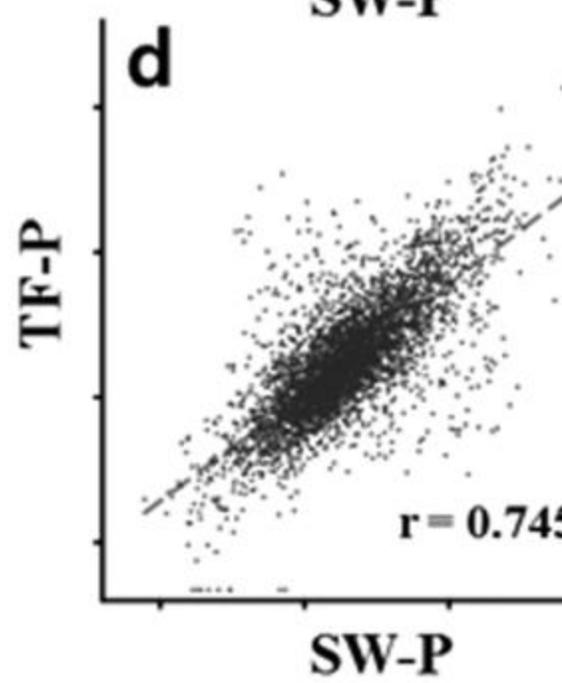
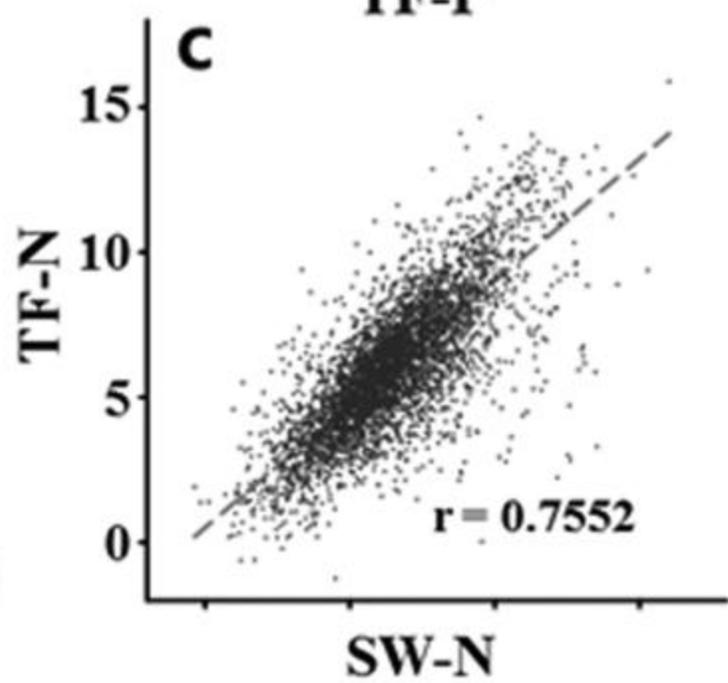
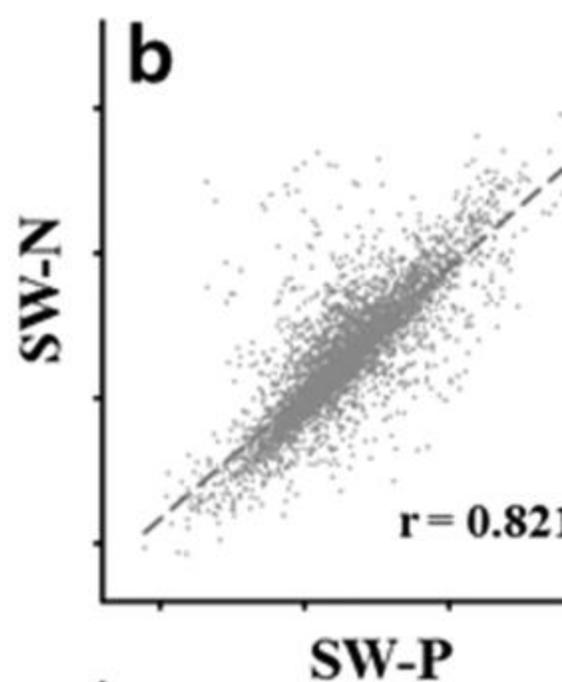
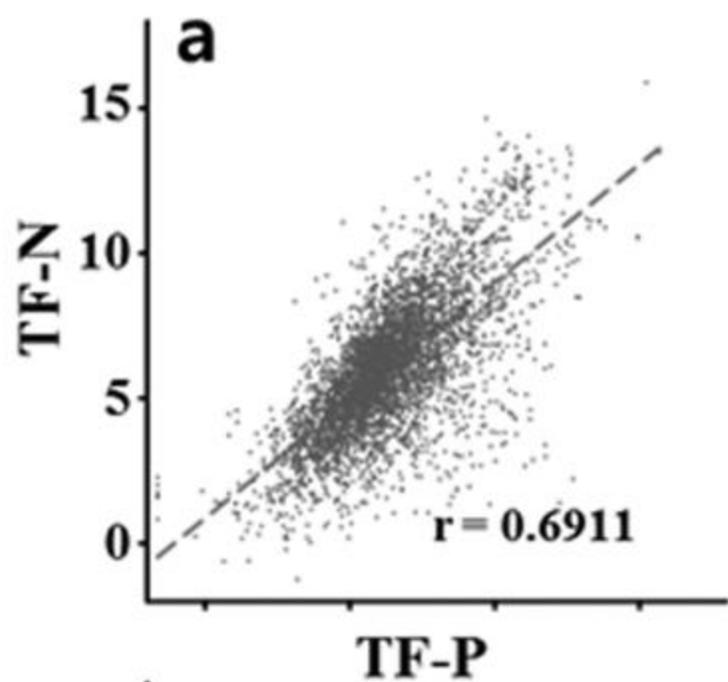


Figure 2

Figures adapted from *Genome-wide transcriptional responses of Alteromonas naphthalenivorans SN2 to contaminated seawater and marine tidal flat sediment* by Hyun mi Jin et al.

6. In Figure 2, which conditions had the highest correlation?

- TF-N and TF-P
- TF-N and SW-N
- TF-P and SW-P
- SW-N and SW-P

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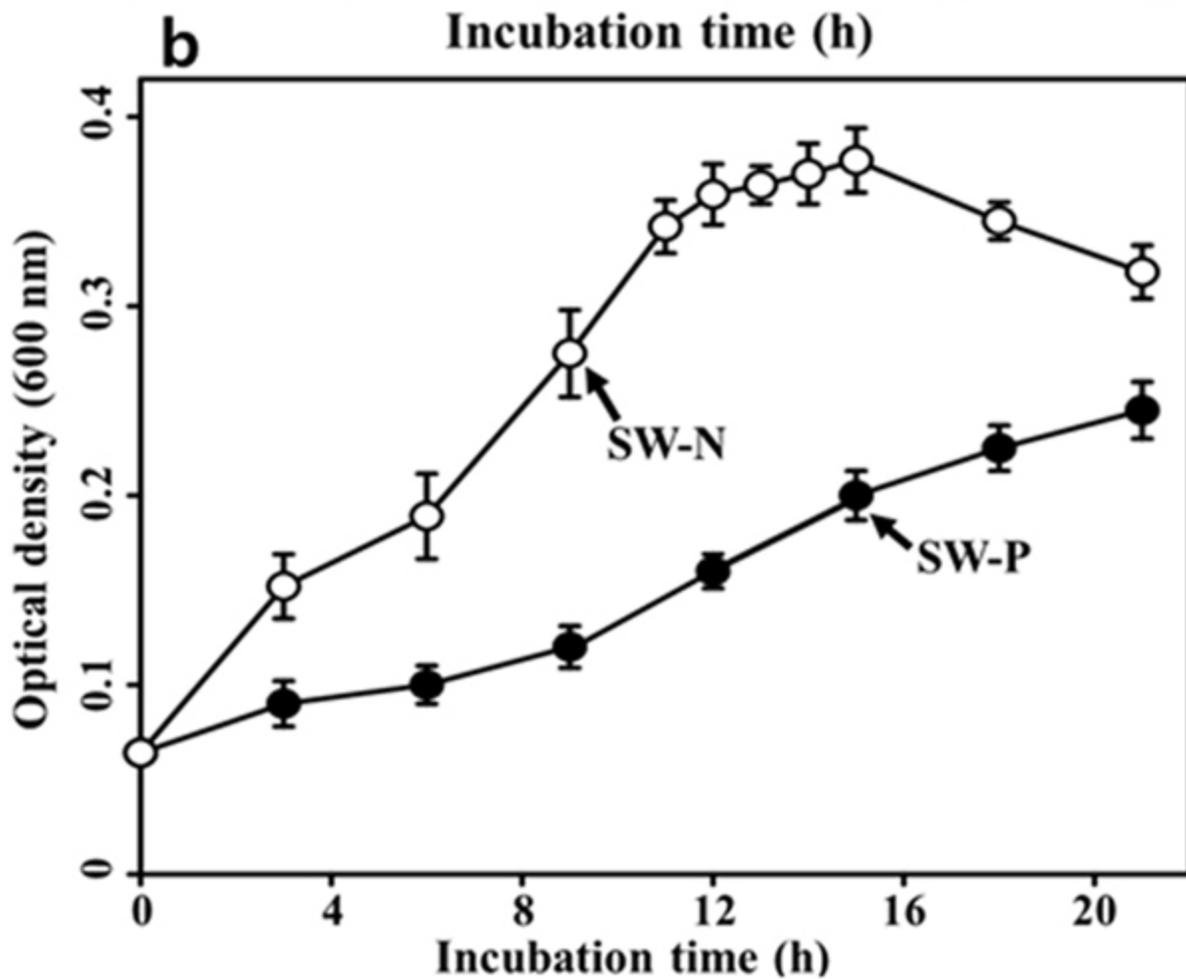
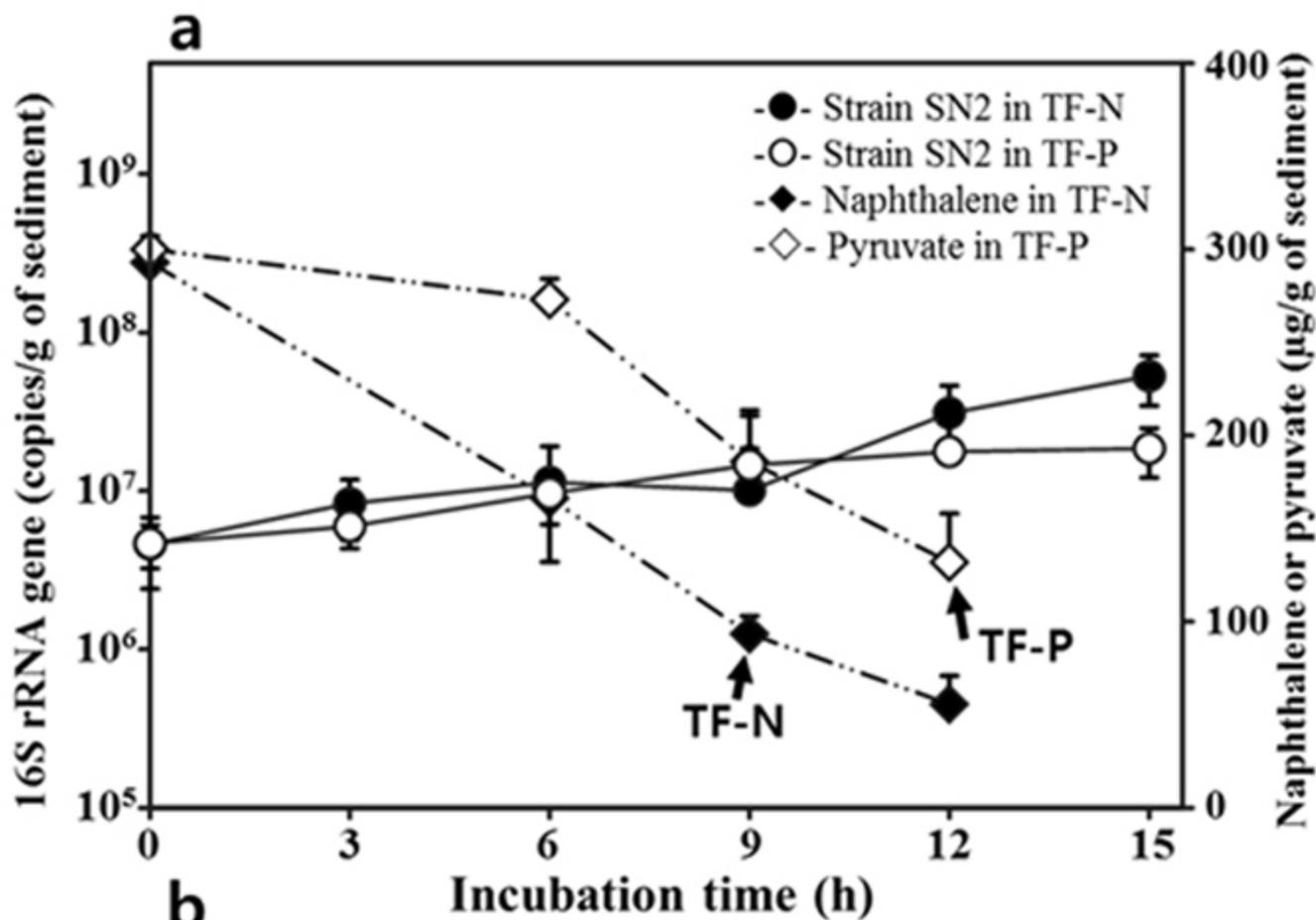


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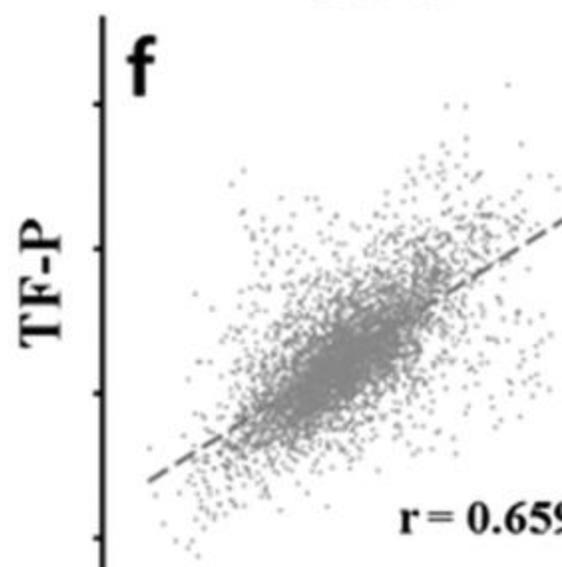
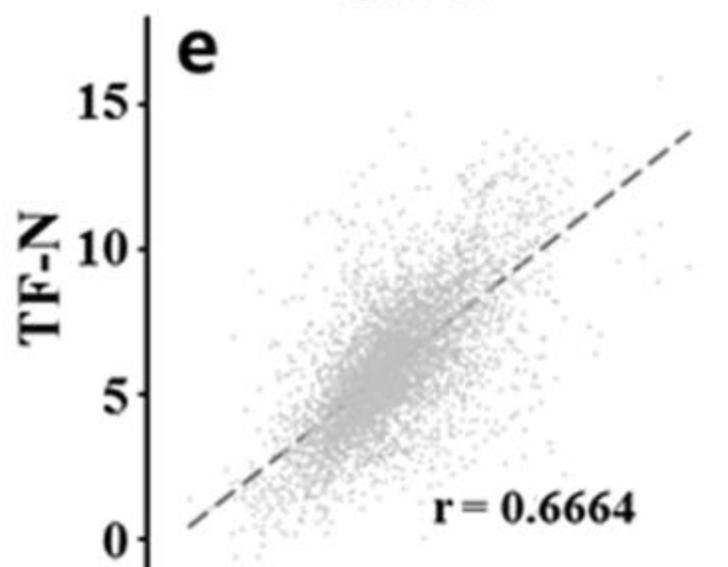
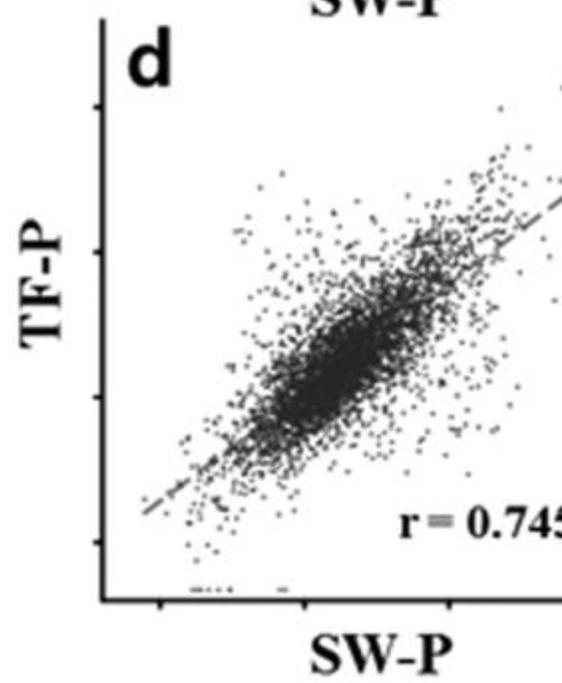
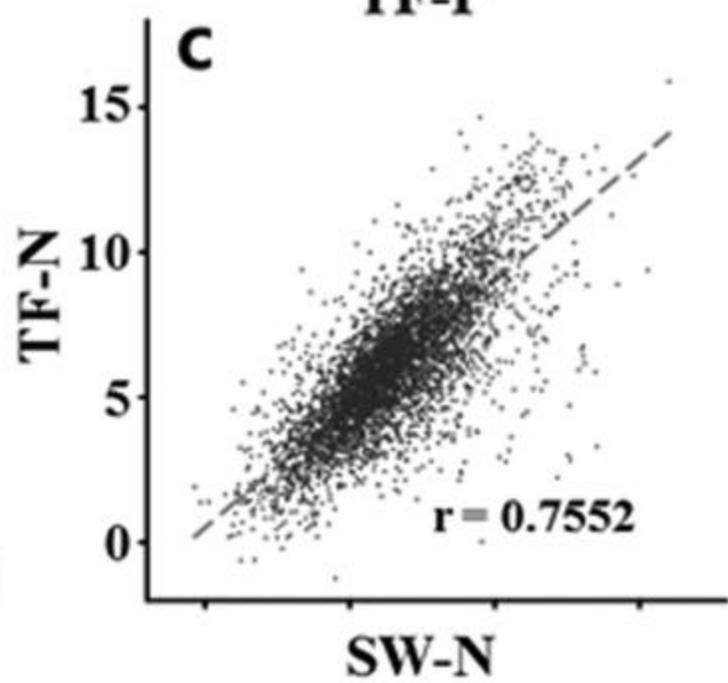
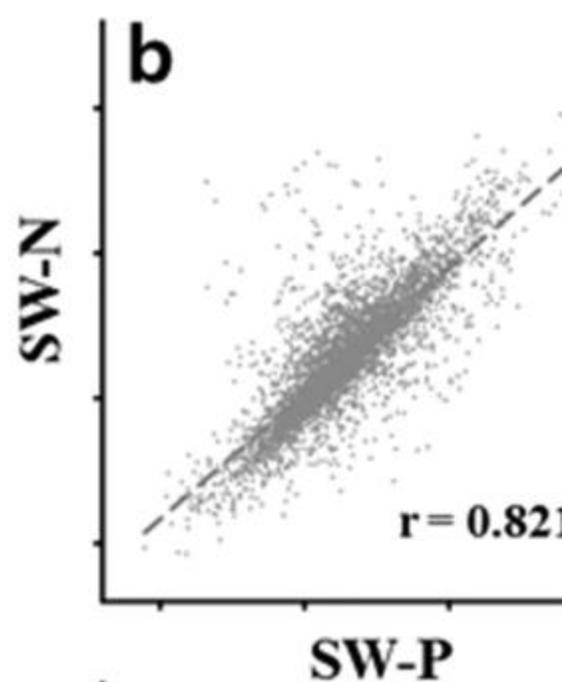
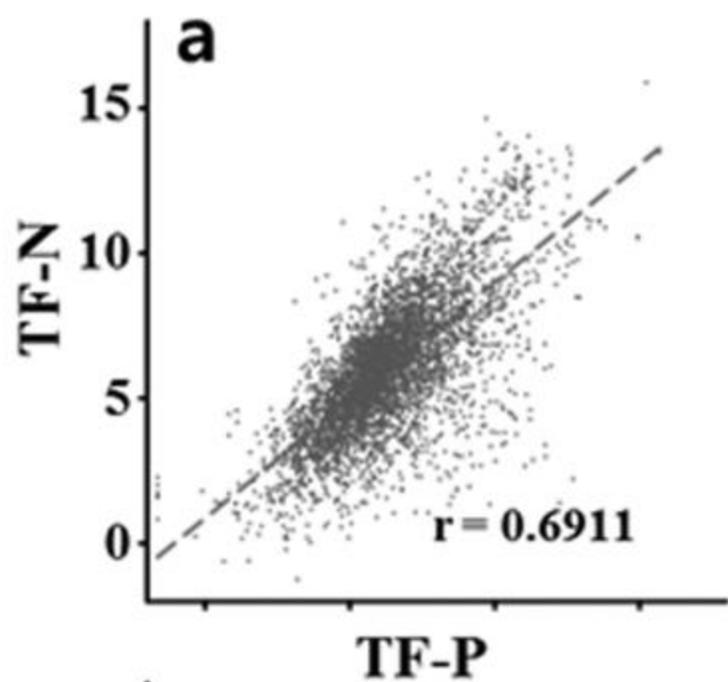


Figure 2

Figures adapted from *Genome-wide transcriptional responses of *Alteromonas naphthalenivorans* SN2 to contaminated seawater and marine tidal flat sediment* by Hyun mi Jin et al.

7. In figure 2, which conditions had the lowest correlation?

- SW-N and SW-P
- TF-N and TF-P
- TF-P and SW-N
- TF-N and SW-P

Use the following passage to answer the next 6 questions:

Researchers studied a species of hibernating black Bears. Each year the Black Bears go into hibernation for a 5-7 month period. During this time, they do not consume any food. Researchers explored the metabolic processes that allow black Bears to survive for so long without eating.

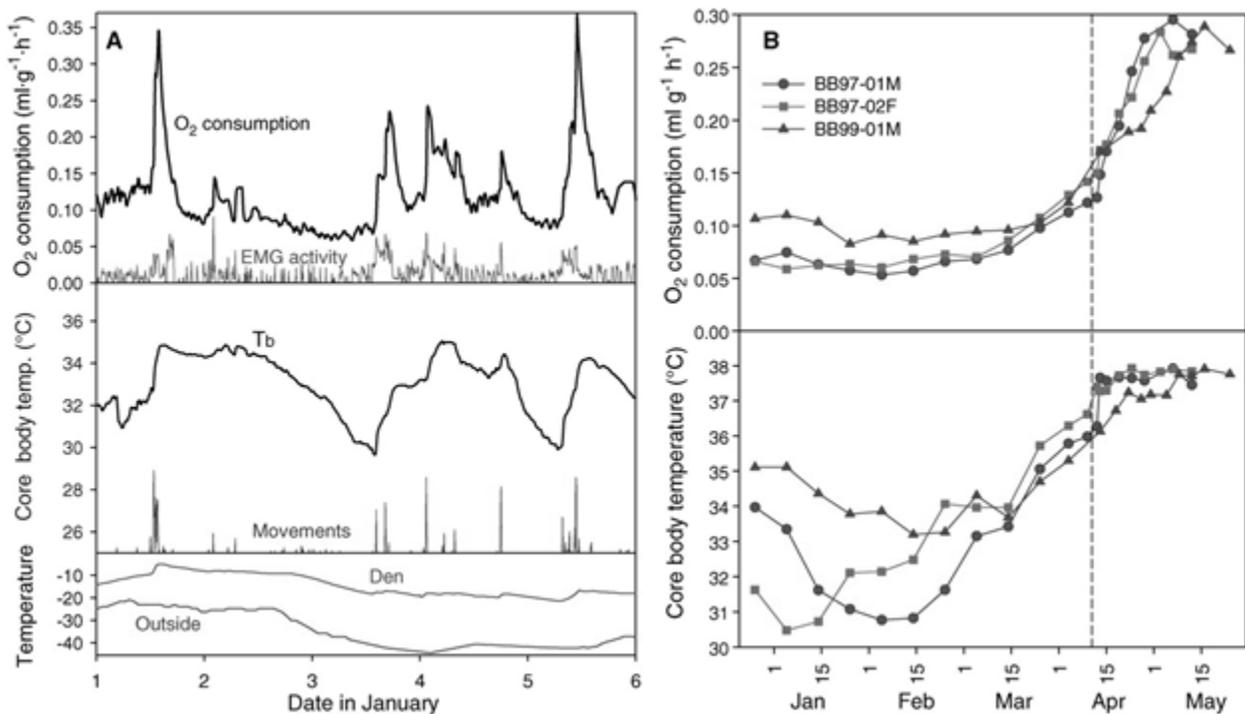


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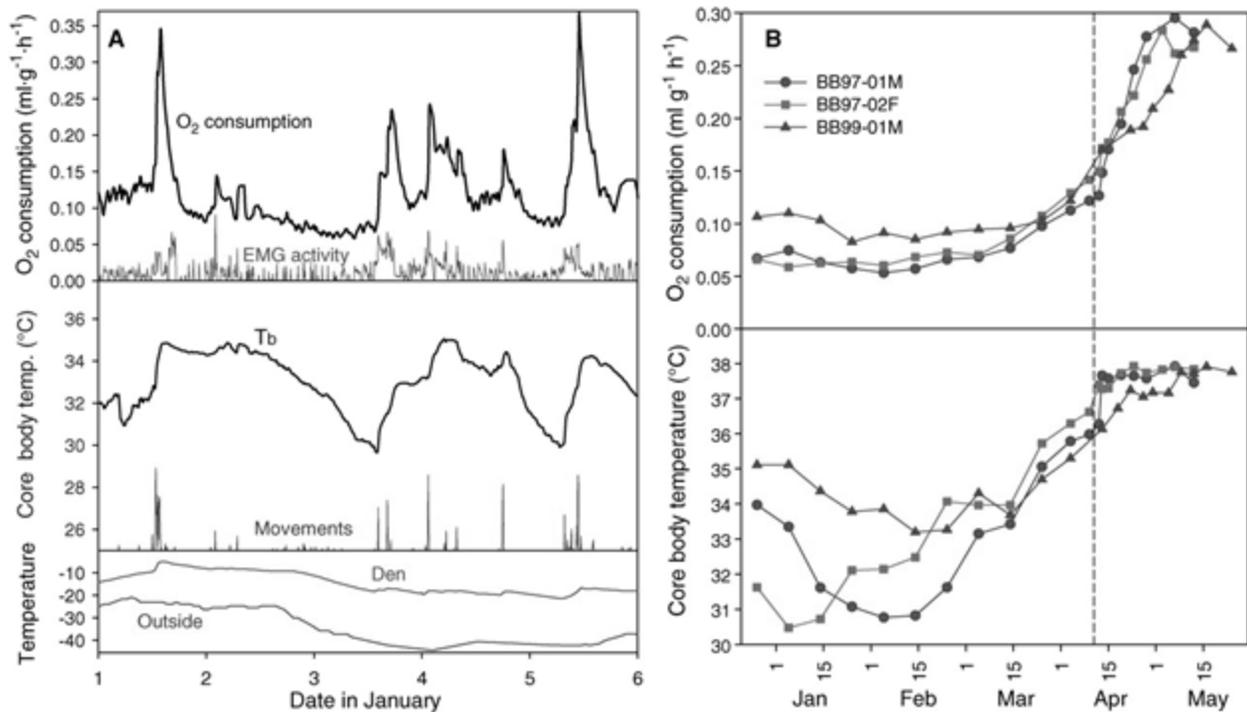


Figure 2

Figures adapted from *Hibernation in Black Bears: Independence of Metabolic Suppression from Body Temperature* by Oivind Toien et al.

Study 1

Researchers gathered black Bears and transported them to facilities in Alaska where they were placed in wooden box habitats. The researchers prepared to measure the Black Bears core body temperature and oxygen consumption during hibernation. Core body temperature was measured through implanted radio transmitters, and oxygen consumption was measured through the constant collection and analysis of air in the habitat. EMG was also surgically implanted to measure electrical activity. Results representative of a typical six-day period during hibernation can be observed in Figure 1.

Study 2

Researchers had additionally installed devices to track the hibernating Black Bears movements including infrared cameras. Once awake, the researchers continued to analyze the Black Bears metabolisms to better understand the process of recovering from hibernation. After having done so, the researchers decided to graph the last several months of hibernation and the post hibernation period, as can be seen in Figure 2. The legend indicates different individual Black Bears. The dashed line indicates the average date the Black Bears woke up from hibernation.

1. What is the lowest core body temperature observed during hibernation (Figure 2)?

- Between 30 and 31 degrees Celsius

- Between 31 and 32 degrees Celsius
- Between 32 and 33 degrees Celsius
- Between 33 and 34 degrees Celsius

2. What is the highest core body temperature observed during hibernation for BB99-01M (Figure 2)?

- Between 30 and 32 degrees Celsius
- Between 32 and 34 degrees Celsius
- Between 34 and 36 degrees Celsius
- Between 36 and 38 degrees Celsius

3. Why was it important that the researchers tracked the hibernating bear's movements in study 2?

- It allowed the researchers to identify the Black Bears eating habits.
- It allowed the researchers to better track the Black Bears core body temperature.
- It allowed the researchers to better identify the Black Bears oxygen consumption.
- It allowed the researchers to identify when the Black Bears awoke from hibernation.

4. What is suggested by the differences in core body temperature between all three Black Bears in Figure 2?

- Black Bears either have a lower core body temperature during hibernation than recovery, or a similar one.
- Black Bears are similar in hibernation and in recovery from hibernation.
- Black Bears differ more in hibernation than in recovery from hibernation.
- Black Bears either have a higher core body temperature during hibernation than recovery, or a similar one.

5. Once awoken, what happens to the Black Bears?

- Their average oxygen consumption increases.

- Their average oxygen consumption decreases.
- Their average oxygen consumption remains the same.
- Their average core body temperature decreases.

6. One of the researchers hypothesized that if the same study were performed again the following year with three new Black Bears instead of the Black Bears from the current studies, the pattern of oxygen consumption would be relatively the same. Do the results of the study support this hypothesis?

- Yes, all three Black Bears experienced a consistent decrease in oxygen consumption, magnifying as more time passed.
- Yes, all three Black Bears experienced a similar trend in oxygen consumption at all time intervals suggesting individual Black Bears do not differ
- No, some Black Bears had several degrees higher body temperature than others at the same point in time.
- No, oxygen consumption as observed in the current study has no clear pattern and is not replicable.