

## Controls and Variables

**SpongeBob and his Bikini Bottom pals have been busy doing a little research. Read the description for each experiment and answer the questions.**

### Patty Power

Mr. Krabs wants to make Bikini Bottoms a nicer place to live. He has created a new sauce that he thinks will reduce the production of body gas associated with eating crabby patties from the Krusty Krab. He recruits 100 customers with a history of gas problems. He has 50 of them (Group A) eat crabby patties with the new sauce. The other 50 (Group B) eat crabby patties with sauce that looks just like new sauce but is really just mixture of mayonnaise and food coloring. Both groups were told that they were getting the sauce that would reduce gas production. Two hours after eating the crabby patties, 30 customers in group A reported having fewer gas problems and 8 customers in group B reported having fewer gas problems.

- 1) Which people are in the control group?
- 2) What is the independent variable?
- 3) What is the dependent variable?
- 4) What should Mr. Krabs' conclusion be?
- 5) Why do you think 8 people in group B reported feeling better?



### Slimotosis

SpongeBob notices that his pal Gary is suffering from slimotosis, which occurs when the shell develops a nasty slime and gives off a horrible odor. His friend Patrick tells him that rubbing seaweed on the shell is the perfect cure, while Sandy says that drinking Dr. Kelp will be a better cure. SpongeBob decides to test this cure by rubbing Gary with seaweed for 1 week and having him drink Dr. Kelp. After a week of treatment, the slime is gone and Gary's shell smells better.



- 6) What was the initial observation?
- 7) What is the independent variable?
- 8) What is the dependent variable?
- 9) What should SpongeBob's conclusion be?

## Marshmallow Muscles

Larry the Lobster was told that a certain muscle cream was the newest best thing on the market and claims to double a person's muscle power when used as part of a muscle-building workout. Interested in this product, he buys the special muscle cream and recruits Patrick and SpongeBob to help him with an experiment. Larry develops a special marshmallow weight-lifting program for Patrick and SpongeBob. He meets with them once every day for a period of 2 weeks and keeps track of their results. Before each session Patrick's arms and back are lathered in the muscle cream, while Sponge Bob's arms and back are lathered with the regular lotion.

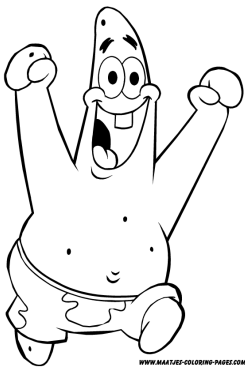
- 10) Which person is in the control group?
- 11) What is the independent variable?
- 12) What is the dependent variable?
- 13) What should Larry's conclusion be?

Time	Patrick	SpongeBob
Initial Amount	18	5
After 1 week	24	9
After 2 weeks	33	17

## Microwave Miracle

Patrick believes that fish that eat food exposed to microwaves will become smarter and would be able to swim through a maze faster. He decides to perform an experiment by placing fish food in a microwave for 20 seconds. He has the fish swim through a maze and records the time it takes for each one to make it to the end. He feeds the special food to 10 fish and gives regular food to 10 others. After 1 week, he has the fish swim through the maze again and records the times for each.

- 14) What was Patrick's hypothesis?
- 15) Which fish are in the control group?
- 16) What is the independent variable?
- 17) What is the dependent variable?
- 18) Look at the results in the charts. What should Patrick's conclusion be?



*Special Food Group*  
(Time in minutes/seconds)

Fish	Before	After
1	1:06	1:00
2	1:54	1:20
3	2:04	1:57
4	2:15	2:20
5	1:27	1:20
6	1:45	1:40
7	1:00	1:15
8	1:28	1:26
9	1:09	1:00
10	2:00	1:43

*Regular Food Group*  
(Time in minutes/seconds)

Fish	Before	After
1	1:09	1:08
2	1:45	1:30
3	2:00	2:05
4	1:30	1:23
5	1:28	1:24
6	2:09	2:00
7	1:25	1:19
8	1:00	1:15
9	2:04	1:57
10	1:34	1:30

## **Krusty Krabs Breath Mints**

Mr. Krabs created a secret ingredient for a breath mint that he thinks will “cure” the bad breath people get from eating crabby patties at the Krusty Krab. He asked 100 customers with a history of bad breath to try his new breath mint. He had fifty customers (Group A) eat a breath mint after they finished eating a crabby patty. The other fifty (Group B) also received a breath mint after they finished the sandwich; however, it was just a regular breath mint and did not have the secret ingredient. Both groups were told that they were getting the breath mint that would cure their bad breath. Two hours after eating the crabby patties, thirty customers in Group A and ten customers in Group B reported having better breath than they normally had after eating crabby patties.

- 19) Which people are in the control group?
- 20) What is the independent variable?
- 21) What is the dependent variable?
- 22) What should Mr. Krabs’ conclusion be?
- 23) Why do you think 10 people in group B reported fresher breath?



## **SpongeBob Clean Pants**

SpongeBob noticed that his favorite pants were not as clean as they used to be. His friend Sandy told him that he should try using Clean-O detergent, a new brand of laundry soap she found at Sail-Mart. SpongeBob made sure to wash one pair of pants in plain water and another pair in water with the Clean-O detergent. After washing both pairs of pants a total of three times, the pants washed in the Clean-O detergent did not appear to be any cleaner than the pants washed in plain water.

- 24) What was the problem SpongeBob wanted to investigate?
- 25) What is the independent variable?
- 26) What is the dependent variable?
- 27) What should Sponge Bob’s conclusion be?

## Squidward's Symphony

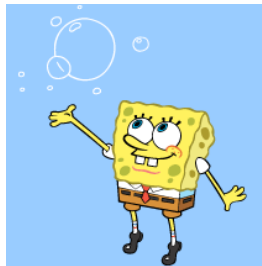
Squidward loves playing his clarinet and believes it attracts more jellyfish than any other instrument he has played. In order to test his hypothesis, Squidward played a song on his clarinet for a total of 5 minutes and counted the number of jellyfish he saw in his front yard. He played the song a total of 3 times on his clarinet and repeated the experiment using a flute and a guitar. He also recorded the number of jellyfish he observed when he was not playing an instrument. The results are shown in the chart.



- 28) What is the independent variable?
- 29) What is the dependent variable?
- 30) What should Squidward's conclusion be?
- 31) Are the results reliable? Why or why not?

**Number of Jellyfish/Instrument**

Trial	No Music	Clarinet	Flute	Guitar
1	5	15	5	12
2	3	10	8	18
3	2	12	9	7



## Super Bubbles

Patrick and SpongeBob love to blow bubbles! Patrick found some Super Bubble Soap at Sail-Mart. The ads claim that Super Bubble Soap will produce bubbles that are twice as big as bubbles made with regular bubble soap. Patrick and SpongeBob made up two samples of bubble solution. One sample was made with 5 oz. of Super Bubble Soap and 5 oz. of water, while the other was made with the same amount of water and 5 oz. of regular bubble soap. Patrick and SpongeBob used their favorite bubble wands to blow 10 different bubbles and did their best to measure the diameter of each one. The results are shown in the chart

**Bubbles**

**(Diameter in centimeters)**

- 32) What did the Super Bubble ads claim?
- 33) What is the independent variable?
- 34) What is the dependent variable?
- 35) Look at the results in the chart.
  - a. Calculate the average diameter for each bubble solution.  
 Super Bubble = \_\_\_\_\_ cm  
 Regular Soap = \_\_\_\_\_ cm
  - b. What should their conclusion be?
- 36) Are the results reliable? Why or why not?

Bubble	Super Bubble	Regular Soap
1	15	10
2	10	5
3	12	16
4	18	14
5	22	11
6	13	12
7	16	11
8	18	15
9	15	15
10	12	6

## Answer Key

### 1 - Patty Power

Which people are in the control group? *Group B*

What is the independent variable? *New sauce*

What is the dependent variable? *Amount of gas*

What should Mr. Krabs' conclusion be? *The new sauce appears to work as it reduced the amount of gas produced in 60% of the people tested.*

Why do you think 10 people in group B reported feeling better? *They thought they were getting the new sauce as a result thought that they didn't have as much gas. (Placebo effect)*

### 2 – Slimotosis

What was the initial observation? *Slimotosis on Gary's shell*

What is the independent variable? *Cures (Seaweed and Dr. Kelp)*

What is the dependent variable? *Slime and odor*

What should Sponge Bob's conclusion be? *Although Gary's symptoms have disappeared, it is not known which cure was the one that worked. He should redo the experiment and include a control group as well as two other testing groups for each of the proposed cures.*

### 3 – Marshmallow Muscles

Which person is in the control group? *SpongeBob*

What is the independent variable? *Muscle cream*

What is the dependent variable? *Amount of marshmallows lifted (strength)*

What should Larry's conclusion be? *Since both Patrick and SpongeBob improved their results by the end of two weeks, it does not appear that the claims for the special muscle cream are true. If the claims were correct, we should have seen Patrick's amount double, but not SpongeBob's amount. The improvements were likely a result of Larry's special workout.*

### 4 – Microwave Miracle

What was Patrick's hypothesis? *He hypothesized that feeding fish microwaved food would make them become smarter.*

Which fish are in the control group? *The fish that eat regular food*

What is the independent variable? *Microwaved food*

What is the dependent variable? *Time required to complete the maze*

Look at the results in the charts. What should Patrick's conclusion be? *According to the data, all but two fish in each group decreased their time through the maze. The special food does not appear to be a big factor in helping fish become smarter.*

*Note: Of the fish that did improve their times, the fish that were fed the special food averaged a 9.625 seconds decrease in their times compared to an average decrease of 6.625 seconds in the fish group that received the regular food. This does show a slight improvement for the microwaved food group, but not enough to prove that his hypothesis was correct. More testing would need to be done.*

## Answer Key

### Krusty Krab Breath Mints

1. Which people are in the control group? *The people who received the mint without the secret ingredient (Group B) would be the control group.*

2. What is the independent variable? *Secret ingredient in the breath mint*

3. What is the dependent variable? *Amount of breath odor (or bad breath)*

4. What should Mr. Krabs' conclusion be? *The breath mint with the secret ingredient appears to reduce the amount of breath odor more than half the time, but it is not 100% effective.*

5. Why do you think 10 people in group B reported fresher breath? *This may be due to the placebo effect.*

### Sponge Bob Clean Pants

6. What was the problem? *SpongeBob's pants were not clean.*

7. What is the independent variable? *Laundry soap*

8. What is the dependent variable? *Amount of dirt left on the pants (or how clean the pants were)*

9. What should Sponge Bob's conclusion be? *Clean-O laundry soap does not appear to be effective in cleaning his pants.*

### Squidward's Symphony

10. What is the independent variable? *Instrument*

11. What is the dependent variable? *Number of jellyfish*

12. What should Squidward's conclusion be? *The clarinet did seem to attract a large number of jellyfish, but the average number for the three trials also matched the average for the guitar. The flute attracted the least number of jellyfish, but the average for this category is still larger than the control. Music seems to attract jellyfish in greater numbers than when no music is played. Squidward's hypothesis that the clarinet attracts larger numbers of jellyfish than other instruments is not proven by this experiment alone.*

13. Are the results reliable? *Based on the limited amount of information provided, it is difficult to tell if Squidward's results are reliable. The description did not tell how long each break was between trials. Did he leave enough time for the jellyfish to "clear out" of the area? (NOTE: Accept other potential flaws that students can support.)*

### **Super Bubbles**

14. What did the Super Bubble ads claim? *The ads claimed that the Super Bubble solution would produce bubbles that were twice as large as those made with regular bubble soap.*

15. What is the independent variable? *Type of bubble solution*

16. What is the dependent variable? *Size (diameter) of the bubble*

17. a. Calculate the average diameter for each. Super Bubble = *15.1 cm* Regular Soap = *11.5 cm*

b. What should their conclusion be? *The Super Bubble solution did not seem to produce bubbles that were twice as large as those made with the regular soap. Although the average size for the Super Bubble solution was larger than the average size for the regular soap, it was not "twice as large" as the ads claimed. In fact, only two of the ten trials had results that would fit the ads claims.*

18. Are the results reliable? Why or why not? *The description does not say who blew the bubbles for each solution. There may be differences in bubble sizes due to the person blowing the bubble rather than the bubble solution. They might have considered having each person blow 5 bubbles with each solution. (NOTE: Accept other potential flaws that students can support.)*