

Rules For Ms. O'Donnell's 6th Grade Class!

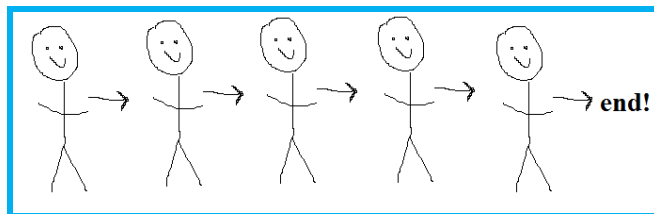


How do we get in line?

There are **THREE** different ways to get in line for Ms. O'Donnell's class!

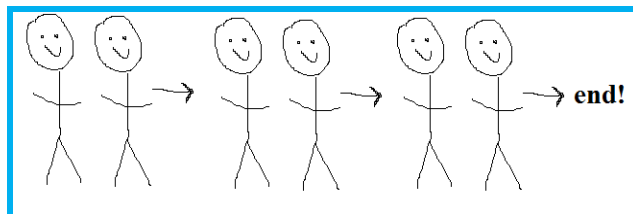
1 The line will start with one person.¹

- One student will start the line, and pick someone to pair up behind him or her.
- Once this student is chosen and has gotten into line, they will then turn around and choose another person to pair up behind them.
- This will continue until all the students have been selected and gotten into line.
- The last person cannot choose anyone else to stand behind them, so the space behind them will be empty. *But they can be the first one that starts off the line next time!*



2 If we want to make a double line, students will pick partners and then line up!!²

- Each student will choose a partner.
- Then, the first pair of students will pick a pair to line up behind them.
- Once this set of students has gotten in line, they will choose another pair to stand behind them.
- This will keep going until all of the student pairs are in line! The last pair cannot choose someone to stand behind them, so it will be empty. *But they can start off the line next time!*



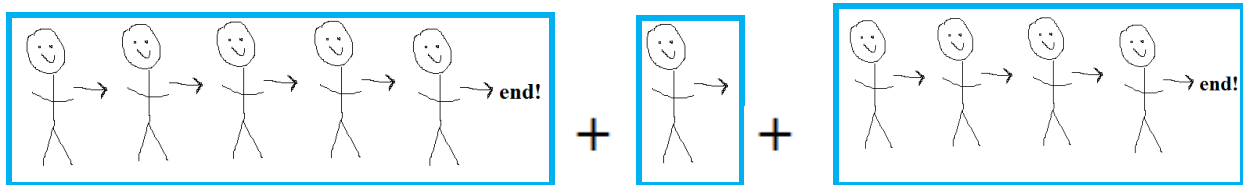
¹ cons

² cons

3

These ways might take a long time, **since there are a lot of students**. Also, everyone always wants to be at the front of the line! To make the time shorter and let more people be at the front of the line, we can divide in half to make two smaller groups. Then we will divide in half again so we have four smaller groups, and we can have each of these groups make lines either way **1** or way **2**. After we have four smaller lines, we will add all of the lines together.*³

- Each line must remain in their original order, and this addition process will only take place with two lines at a time (since more than two lines will be too confusing!)
- The first person of the second line will be added to the end of the first line, and then this same process will take place with the whole rest of the second line.
- When there are no more students to add from the second line, the result is the new line that is the addition of both lines!



First line + **the first person of second line**⁴ → **Then the rest of the line one by one!**⁵

How do we know the whole class is in line?

How can we tell how many students are in line?

³ list-append

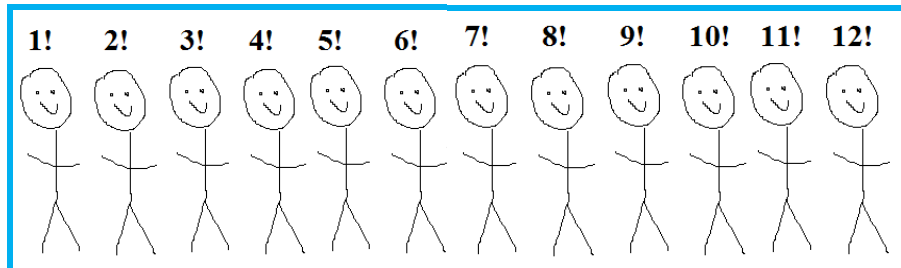
⁴ car of line

⁵ cdr of line

counting off in order!⁶

We can check by

- If there is no one in line, then the number of students in line is 0!
- If there are students in line, the first student will shout out “One!”
- After this student has said the number, the next student will say the number that comes after that!
- The final number that is said (the number the final student in line shouts out!) is how many students are in line. This should be the amount of students in our class!



But when we are going to the bathroom, we need to make

two different lines!

boys

girls

One line for and one line for

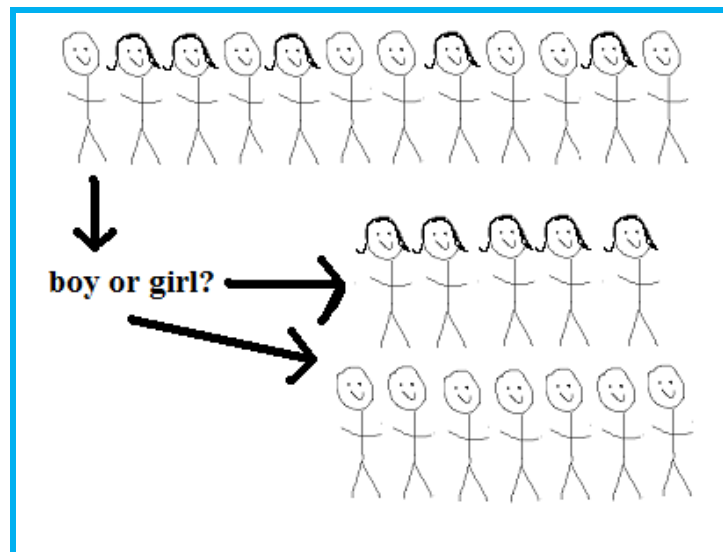
How do we separate boys from girls to make two new lines?

⁶ list-length

We will go through the line and **check**

whether each individual student is a boy or a girl!*⁷

- Starting with the first student, we will check if it is a boy or a girl.
- If it is a boy, he will stay in line and we will move on to check the next student!
- If the first student is a girl, we will pull her out of the line to start a new line and move on to the next student.
- For the rest of the students, if they are boys they will stay in line, but if they are girls they will be pulled out and added to the new line



This way we will have
two new lines!

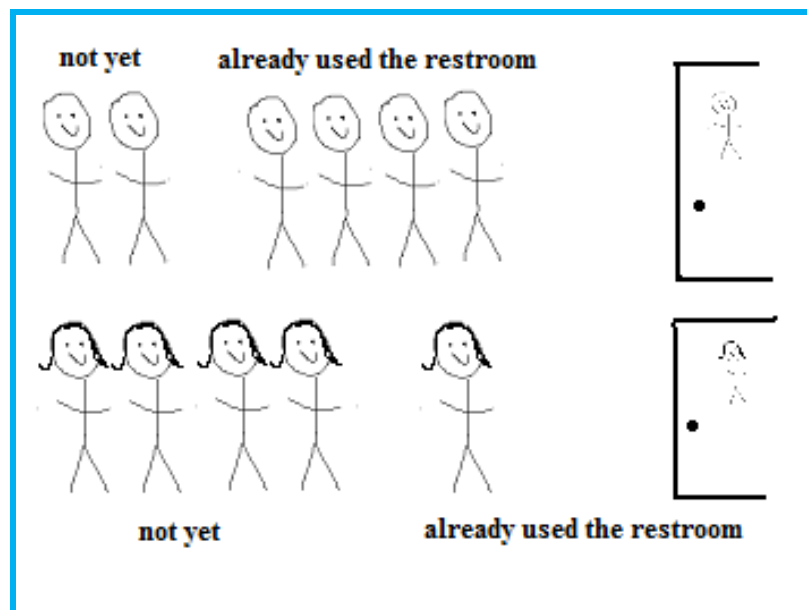
**How can we make sure everyone has
a chance to use the bathroom?**

⁷ list-filter

We will work through the line

so that only one person uses each facility at a time!⁸

- The first person will use the bathroom, and when they are finished they will return to their place in the line
- The next person will then go and return to their place in line
- This will continue down the line until everyone has gone.



The result is a line of students who
have all used the bathroom!

We can use this same system when we go to the water fountain!

⁸ list-map

*Artistic license

*Artistic license was taken with the list-append procedure, since list-append actually works with the first input.

```
(define (list-append p q)
  (if (null? p) q
      (cons (car p) (list-append (cdr p) q))))
```

*It checks that p isn't null, and if it is not it adds the car of p to the recursive call on the cdr of p and the second list of q.

Since that would make less sense when getting into line, I instead added the car of the second line onto the end of the first line. Thus my list-append adaptation goes through the second line, q, and adds the car of q onto the end of p while calling the append procedure onto the cdr of q. When q is null, it is the resulting new list of p that is left.

Artistic license was taken with my adaptation of the list-filter procedure.

```
(define (list-filter test p)
  (if (null? p) null
      (if (test (car p))
          (cons (car p) (list-filter test (cdr p)))
          (list-filter test (cdr p)))))
```

Since the girls pulled out of line couldn't just be discarded (since they are students and people!) I instead had them begin a new line, since they need a line as well. Having half the class in line and half out of line wouldn't be too orderly. So while (car p) here just disappears if it does not pass the test, in my adaptation it is moved to a different list.