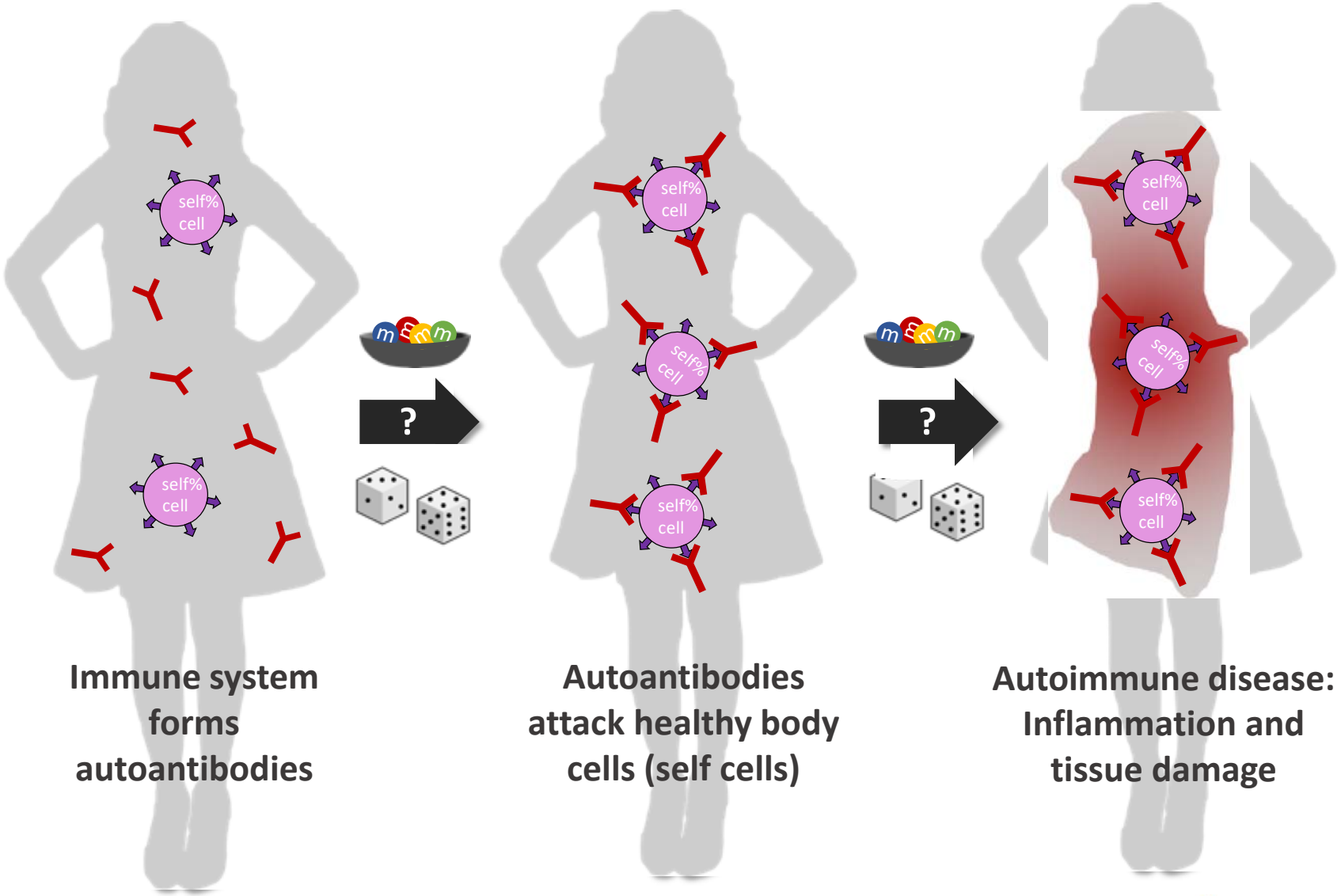
# Model the Chances of Getting an Autoimmune Disease




**Immune system forms autoantibodies**

**Autoantibodies attack healthy body cells (self cells)**

**Autoimmune disease: Inflammation and tissue damage**

# Simplified model of an autoimmune response

## Checkpoint 1

Check if immune cells produce autoantibodies that attack healthy body cells before they leave the organs where they are produced.

**The body must destroy autoantibodies before they can cause an autoimmune disease.**

## Checkpoint 2

Check if immune cells can stop autoantibodies that attack healthy body cells during an infection.

**Immune cells need to do their job correctly to prevent an autoimmune disease.**

## Checkpoint 3

Check if immune cells destroy themselves to stop the immune response after an infection.

**If immune cells fail to destroy themselves, it can lead to an autoimmune disease.**

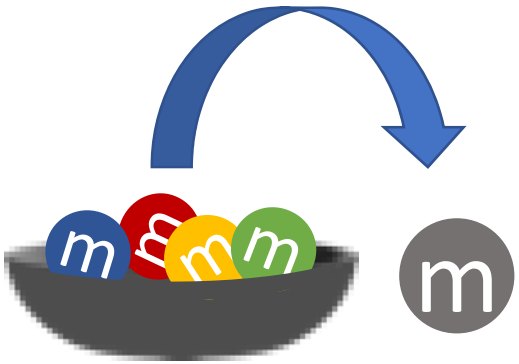
# Apply probability concepts to model likelihood of getting an autoimmune disease

One M&M color represents a student's own body cells.

Pick random M&M. If color matches, an autoimmune response happens.

Roll die to see if immune system can prevent an autoimmune disease.

Draw a random M&M color



Match

No match

Roll a die



Fail

**Autoimmune disease**

Pass

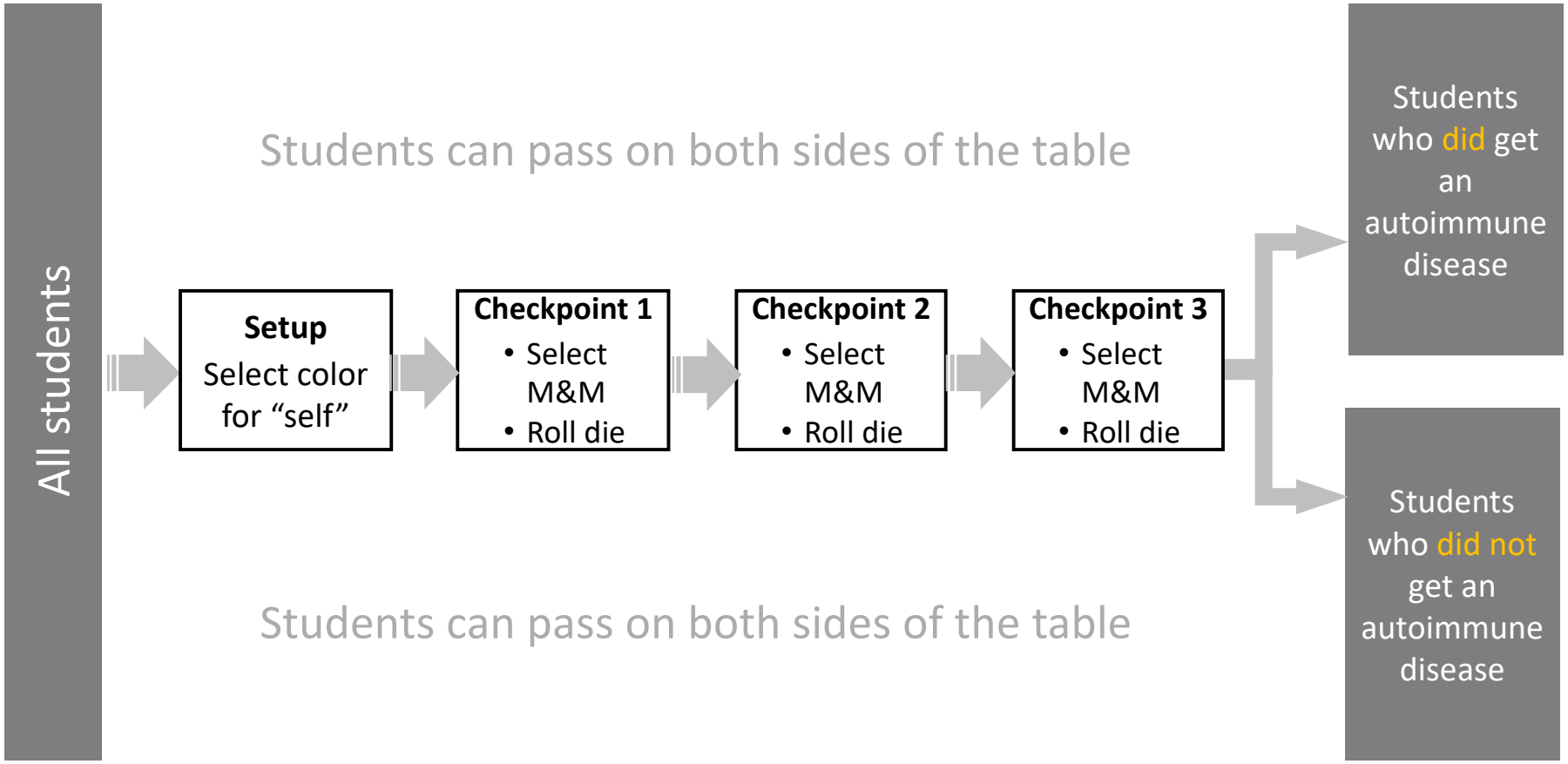
**No autoimmune disease**

continue to next step

**No autoimmune disease**

continue to next step

# Classroom setup for your experiment



# Simulation 1: no predisposition

*Follow instructions at station 1*

# Setup



Without looking, select an M&M color from the bowl

*The selected color will be the body's label for its own cells, the "self"*

**Record this color on your log sheet and remember it during all the three checkpoints!**

# Simulation 1: no predisposition

*Follow instructions at station 2*

## Checkpoint 1

*Do immune cells develop autoimmunity before they leave their organs?*



Without looking, take a random M&M color from the bowl

Match with "self" color: Cell is autoreactive

No match with "self" color: Cell is not autoreactive

*Does autoreactive cell escape the organ?*

**No Autoimmune disease!** Go to Checkpoint 2

Roll a die

6

Yes

**Autoimmune disease!** Go to the respective area in your classroom

1,2,3,4,5

No

**No Autoimmune disease!** Go to Checkpoint 2

**Record your results on your log sheet!**

# Simulation 1: no predisposition

*Follow instructions at station 3*

## Checkpoint 2

*Do immune cells stop an autoimmune response during an infection?*



Without looking, take a random M&M color from the bowl

Match with "self" color: Autoimmunity occurs

No match with "self" color: Autoimmunity does not occur

**No Autoimmune disease!**
Go to Checkpoint 3

*Can immune system stop the resulting autoimmunity?*

Roll a die

Predisposed: 2,3,4,5,6

6

No

**Autoimmune disease!**
Go to the respective area in your classroom

1,2,3,4,5

Yes

**No Autoimmune disease!**
Go to Checkpoint 3

Predisposed: 1

**Record your results on your log sheet!**

# Simulation 1: no predisposition

*Follow instructions at station 4*

## Checkpoint 3

*Do immune cells destroy themselves to stop the immune response after an infection?*



Without looking, take a random M&M color from the bowl

Match with "self" color: Cells do not destroy themselves

No match with "self" color: Cells destroy themselves

**No Autoimmune disease!** Go to the respective area in your classroom

*Can autoimmune disease still be prevented?*

Roll a die

Predisposed: 2,3,4,5,6

6

No

**Autoimmune disease!** Go to the respective area in your classroom

1,2,3,4,5

Yes

**No Autoimmune disease!** Go to the respective area in your classroom

Predisposed: 1

**Record your results on your log sheet!**

## Results, simulation 1

*How many students did or did not get an autoimmune disease?*



## Simulation 2: with predisposition

Repeat simulation 1 with changed probabilities (light grey boxes) at Checkpoints 2 and 3

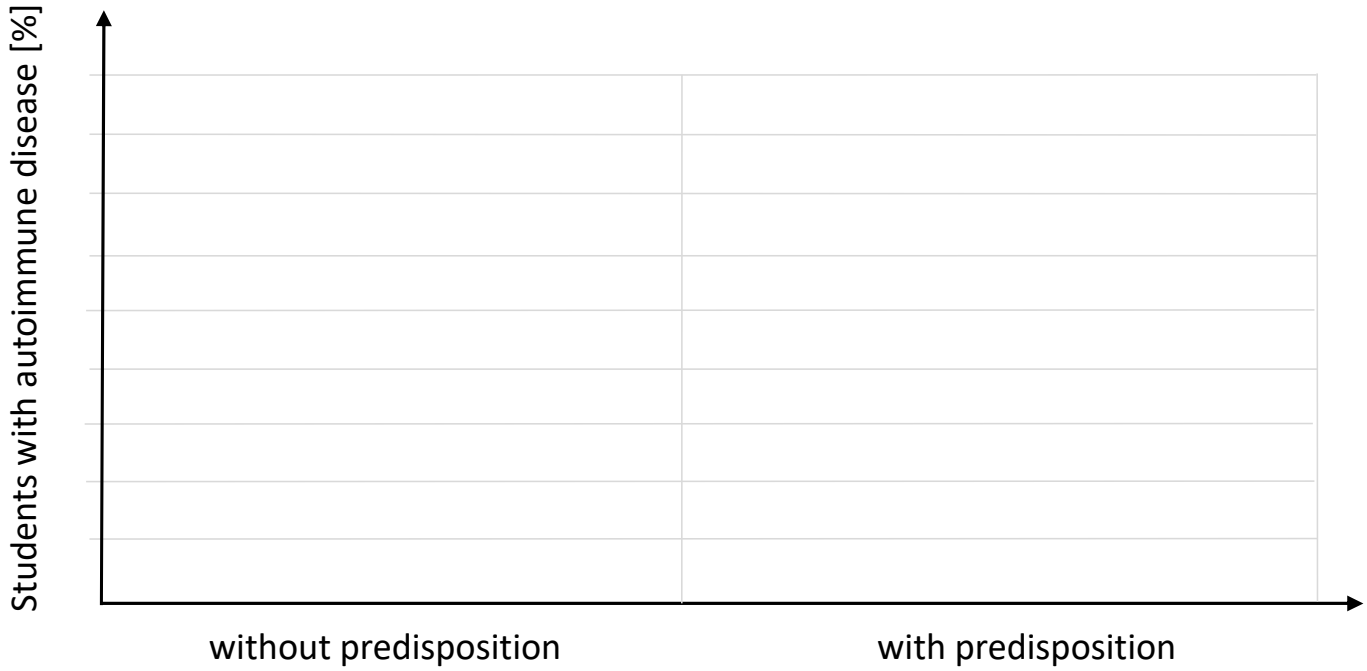


## Results, simulation 2

*How many students did or did not get an autoimmune disease?*

# Data Analysis

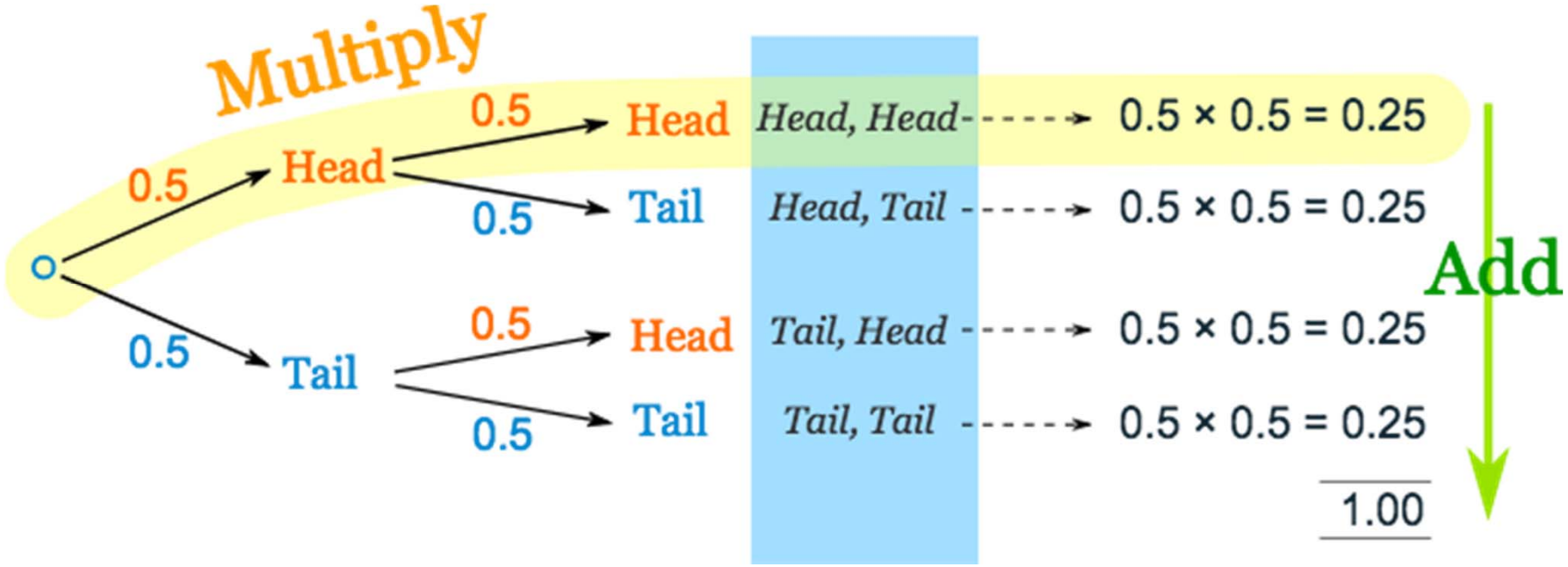
| | Simulation without predisposition | Simulation with predisposition |
|---|---|---|
| Students with autoimmune disease [%] | | |
| Students without autoimmune disease [%] | | |



**Optional:**

- **calculating probabilities**
- **drawing probability tree**

Sample probability tree and calculations for throwing a coin:




- Multiply probabilities along a path/branch
- Add individual probabilities of each path/branch