SEEING THE WHOLE PICTURE: RODS & CONES

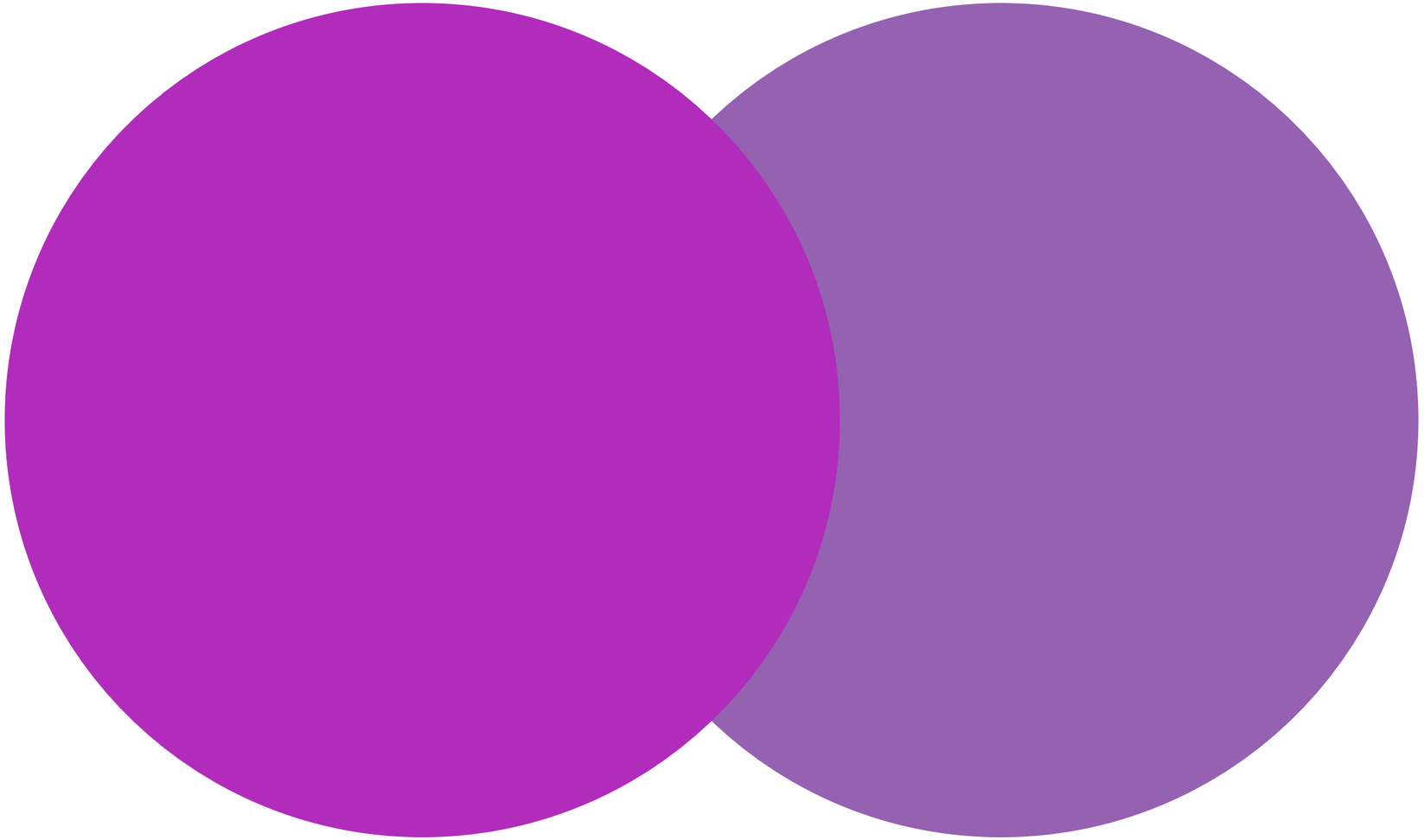
PROMISE

SANFORD RESEARCH

LET'S DO A VISION TEST!

You will see 20 sets of colored circles. For each set, try to determine whether the left (L) or right (R) circle is overlapping the other. After 5 sets, you will rotate your body and repeat. Record your guesses in your lab notebook and put an X through the ones you get wrong.

1



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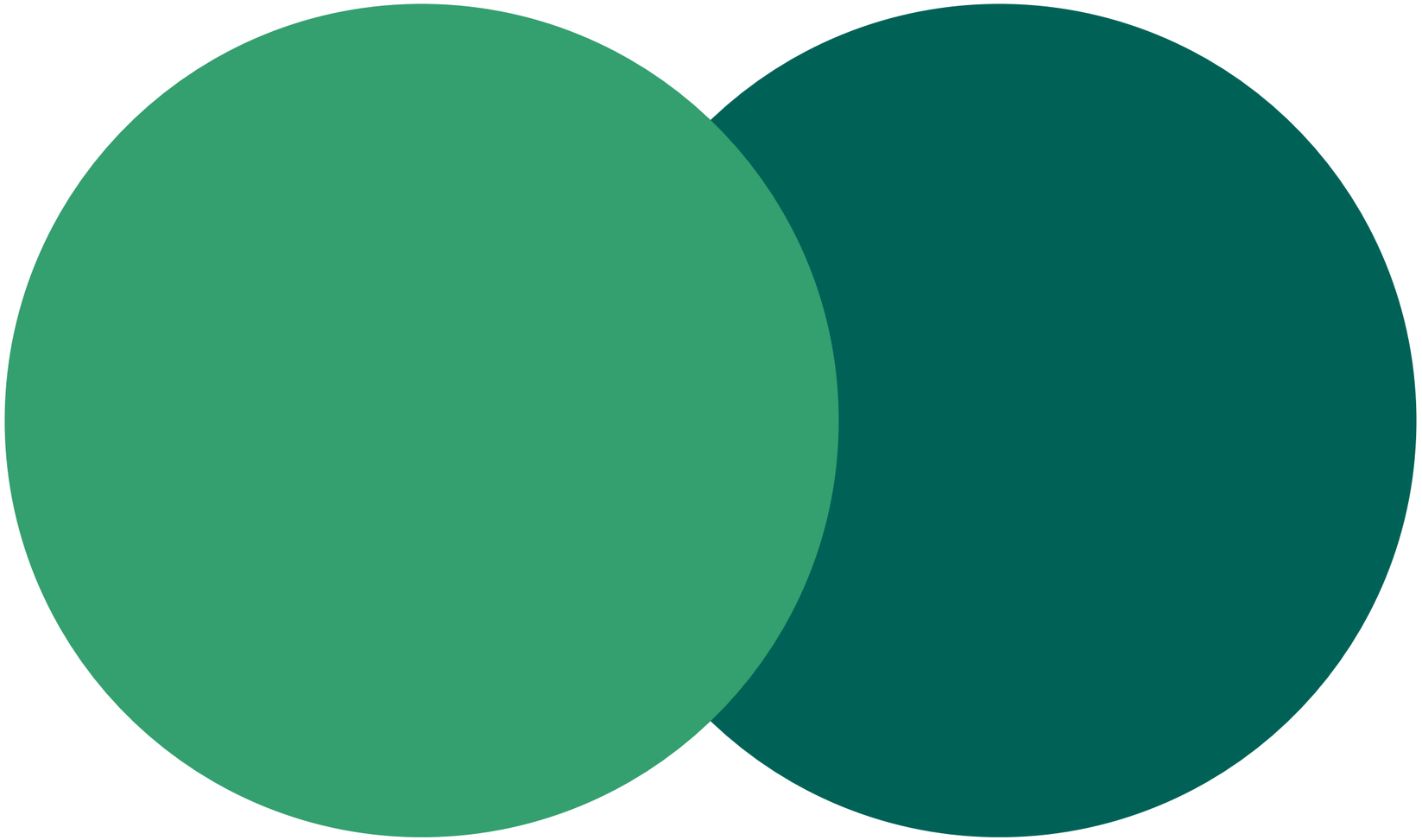

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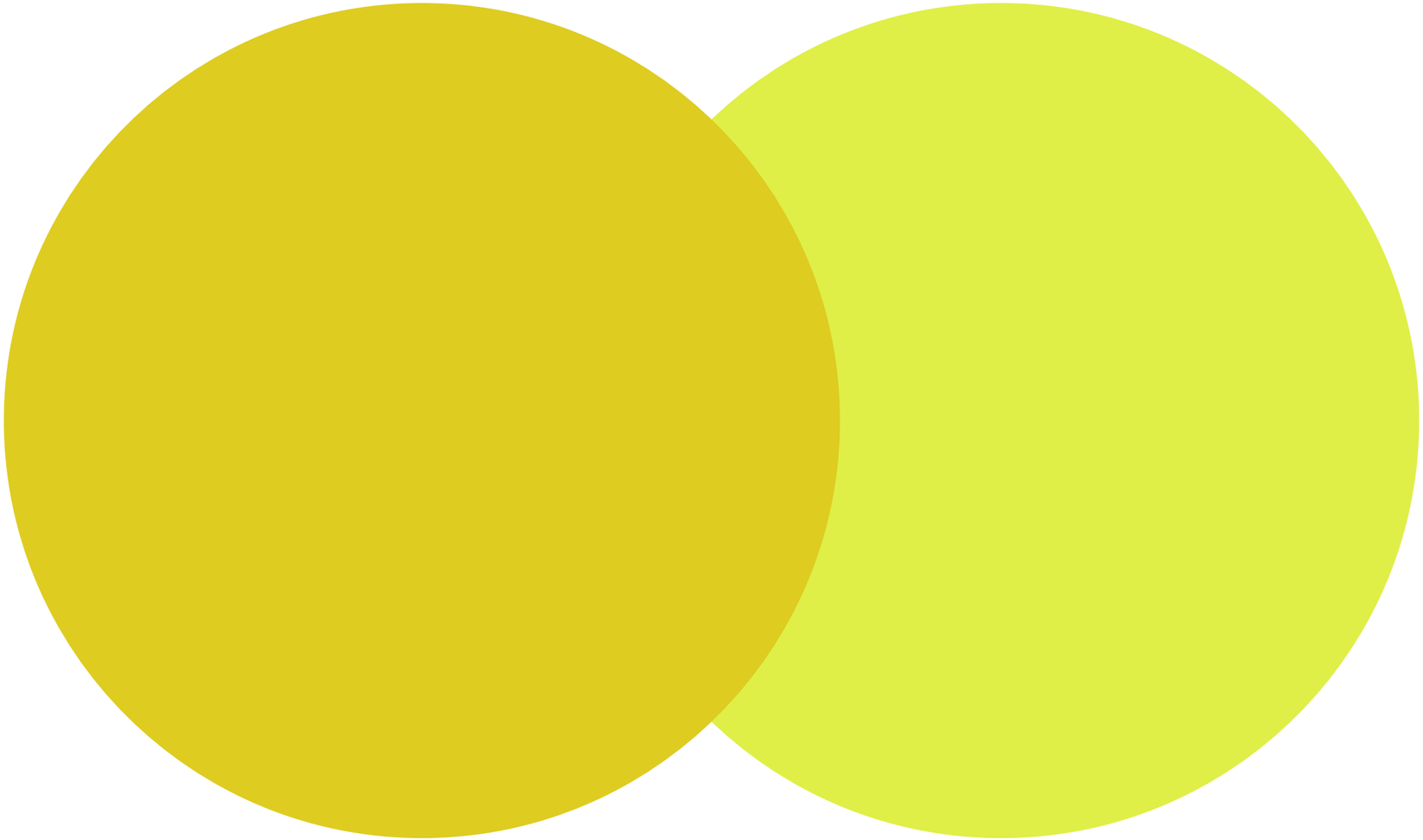

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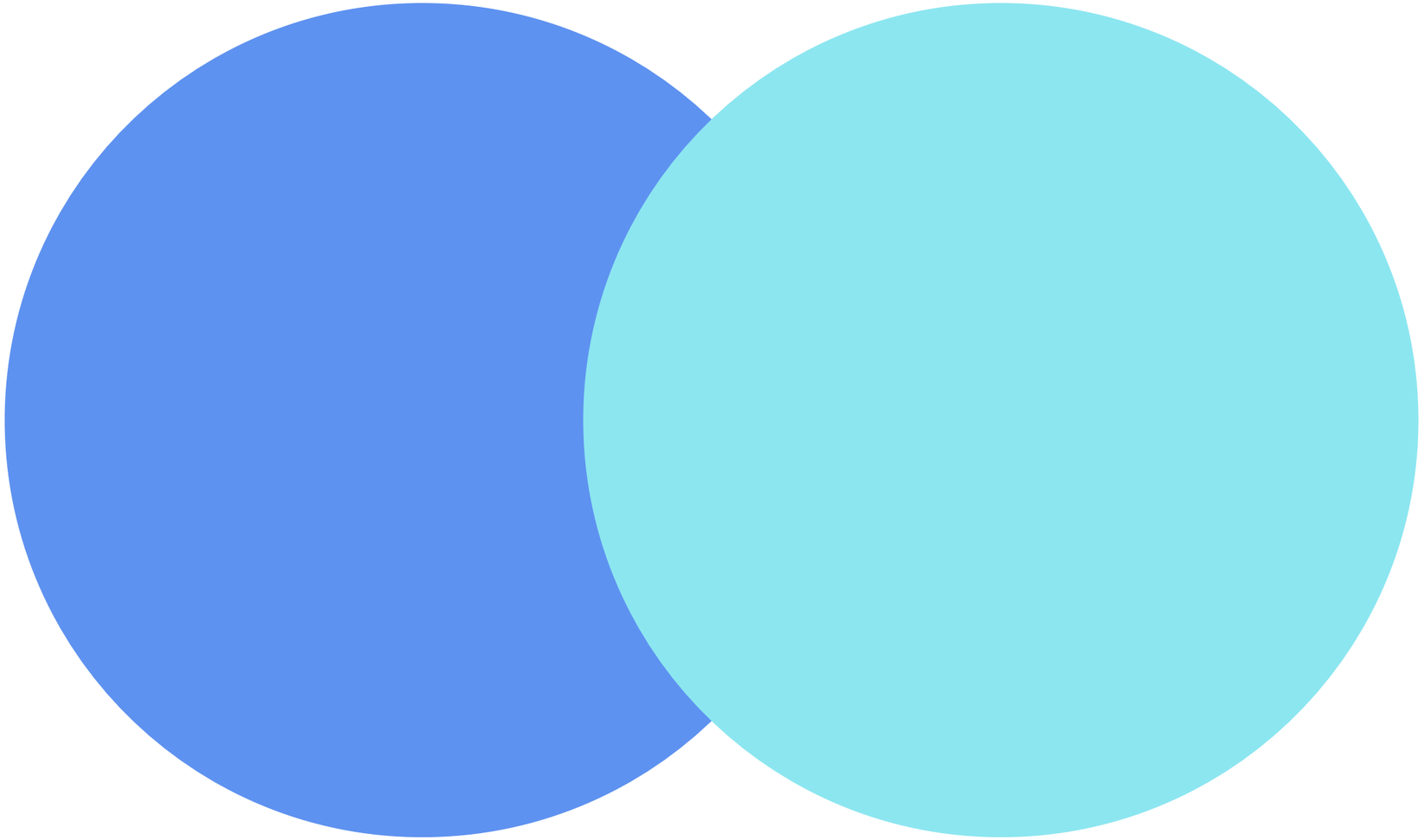

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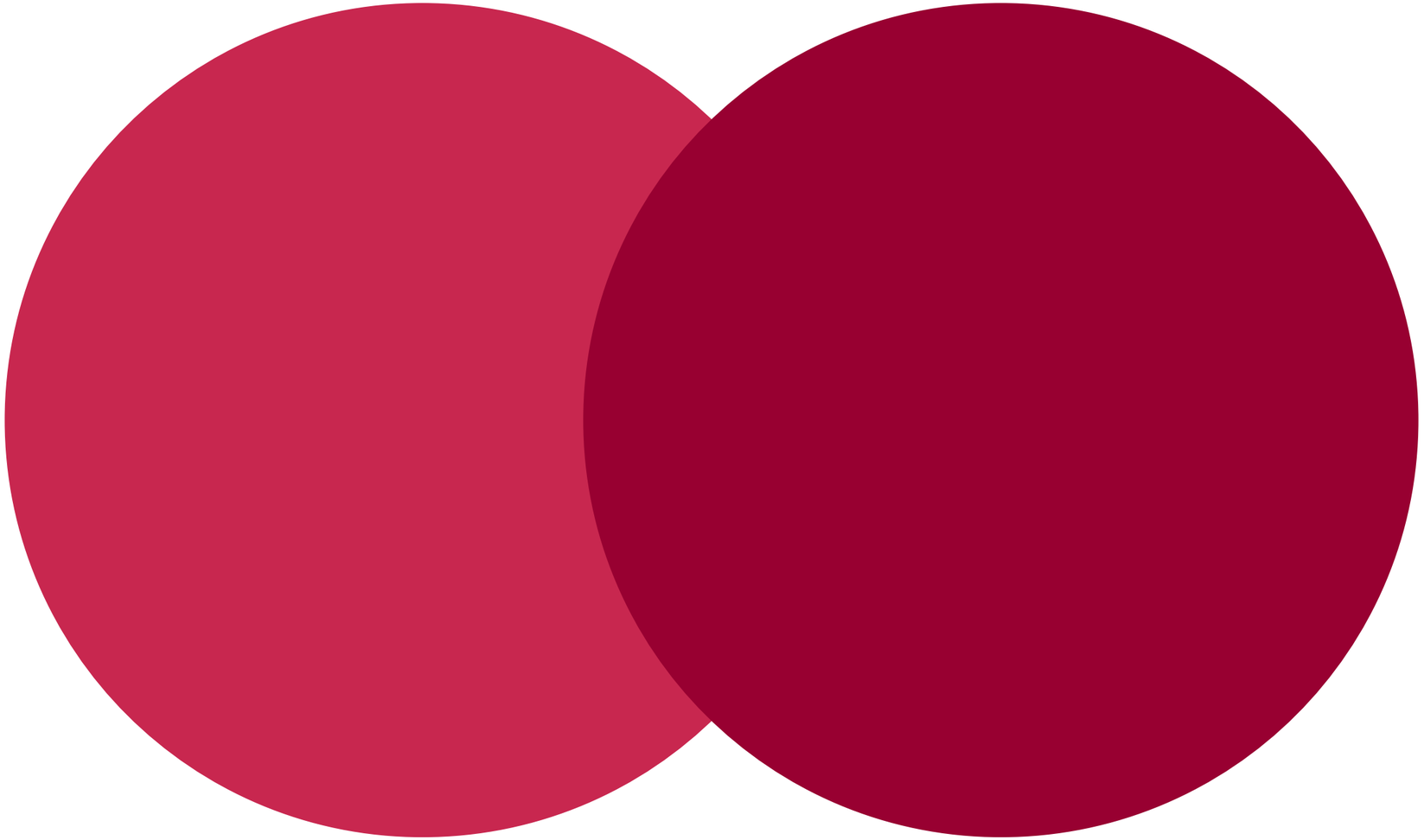
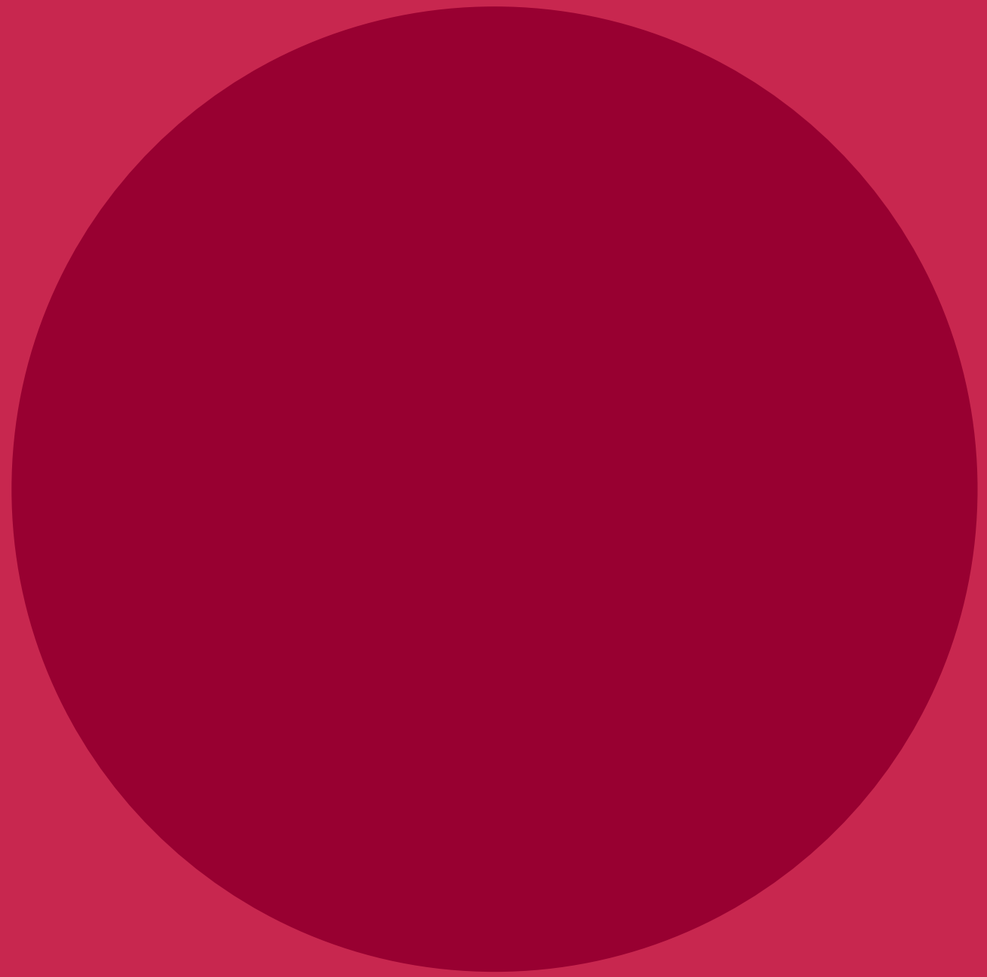
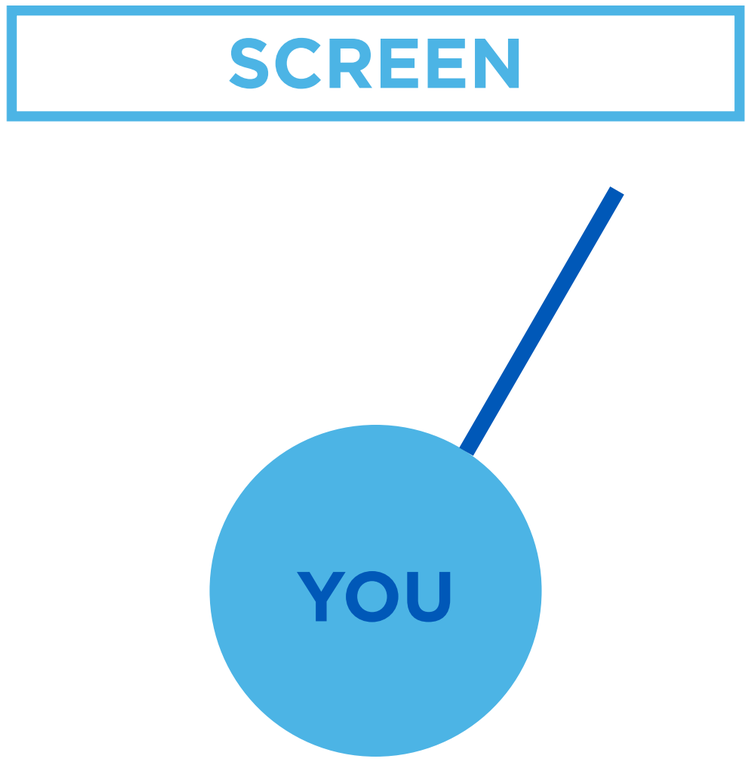


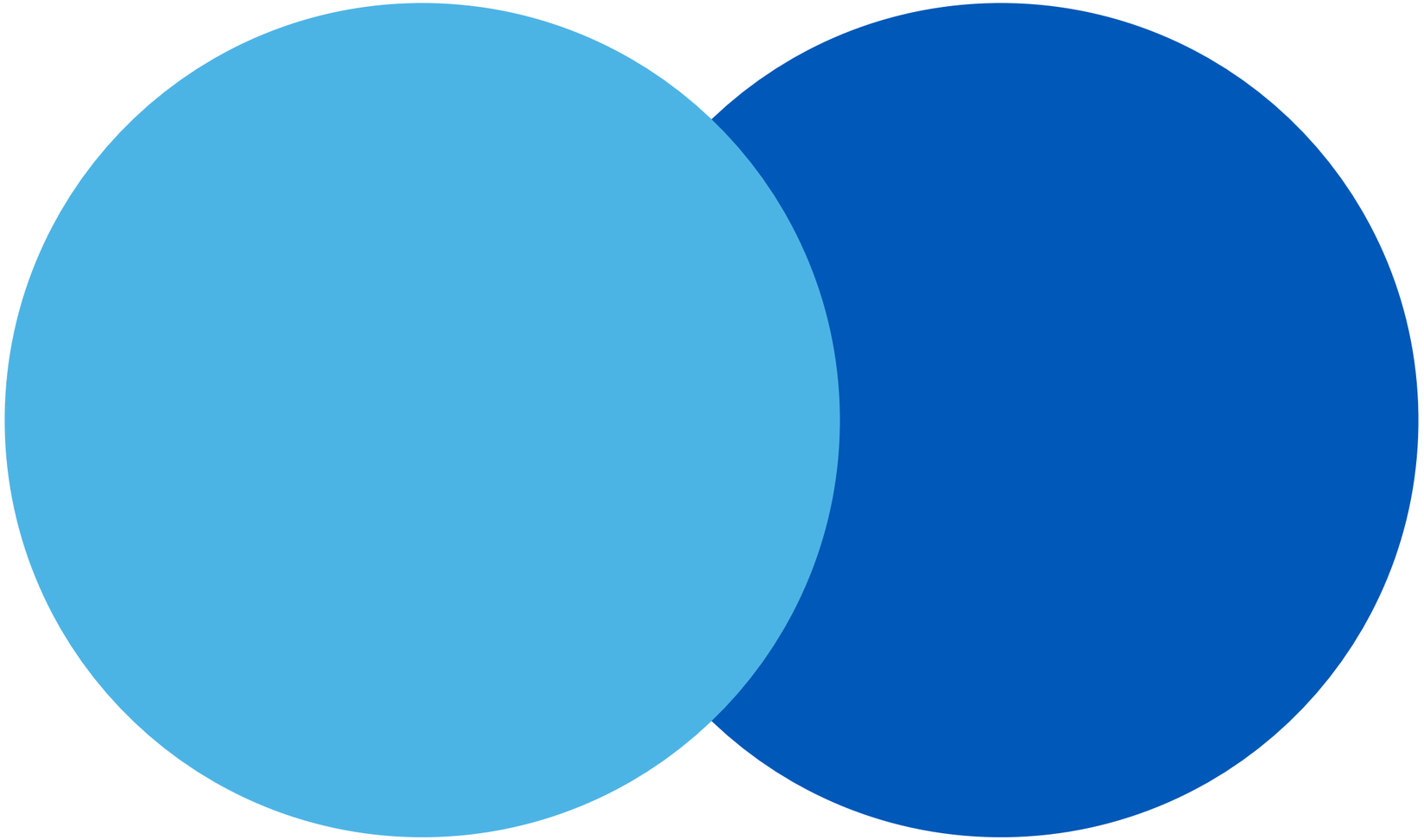


ON TO SET TWO!



For the next set of colored circles, turn your body, head, and gaze 30 degrees to the right. Answer the questions while not looking directly at the screen.

1



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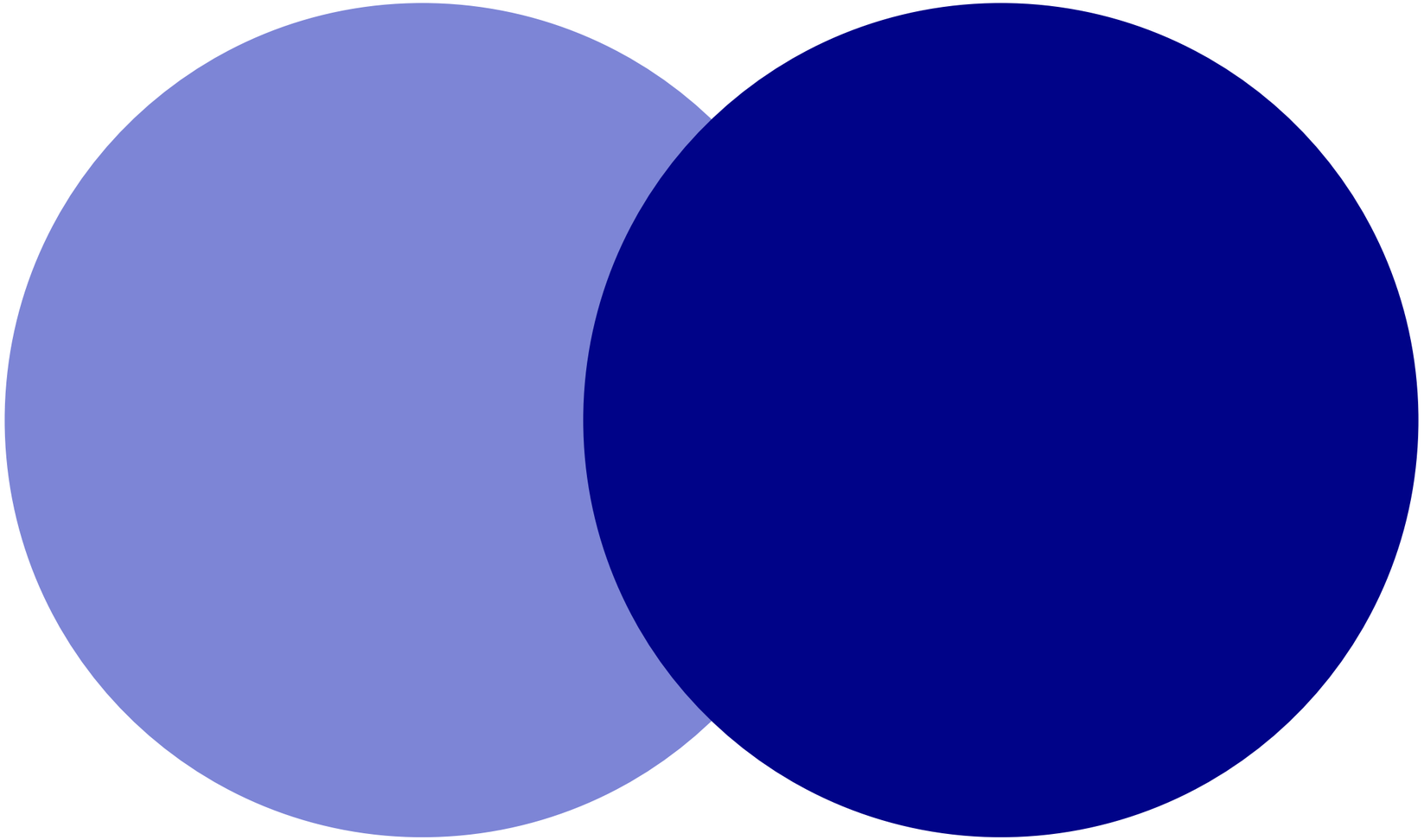

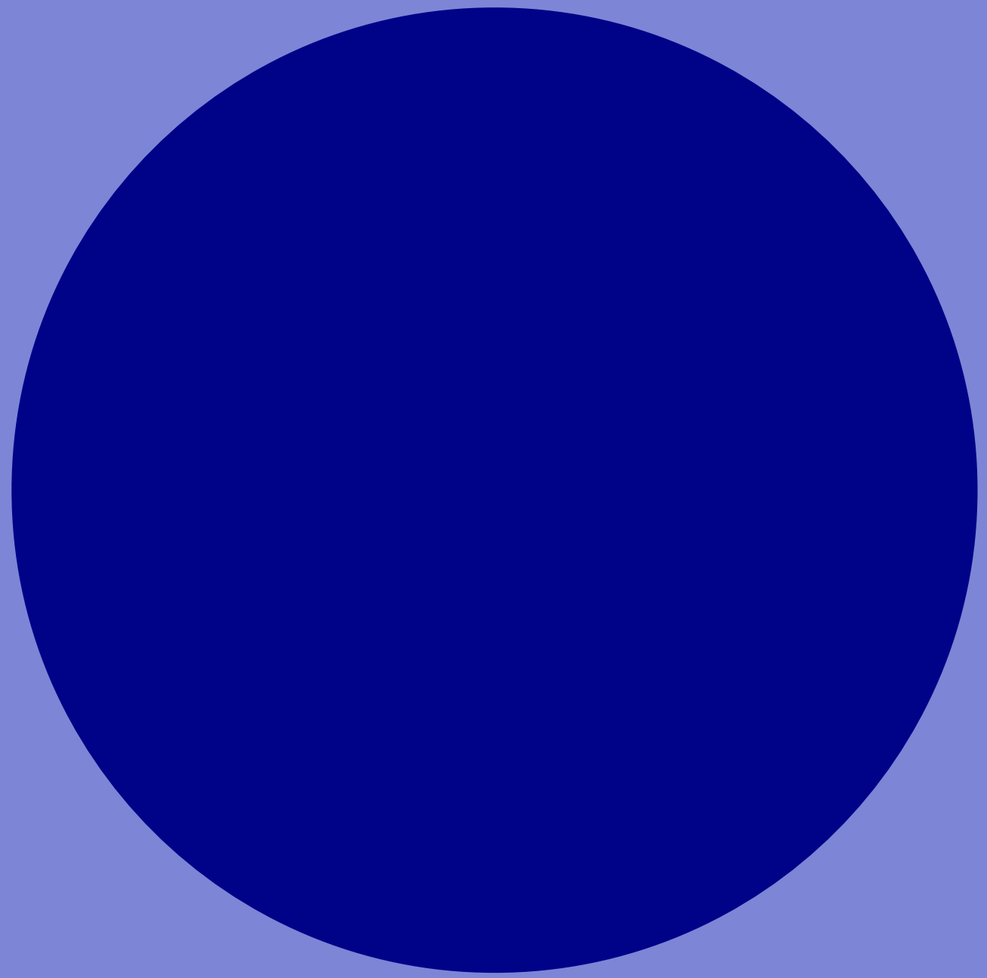

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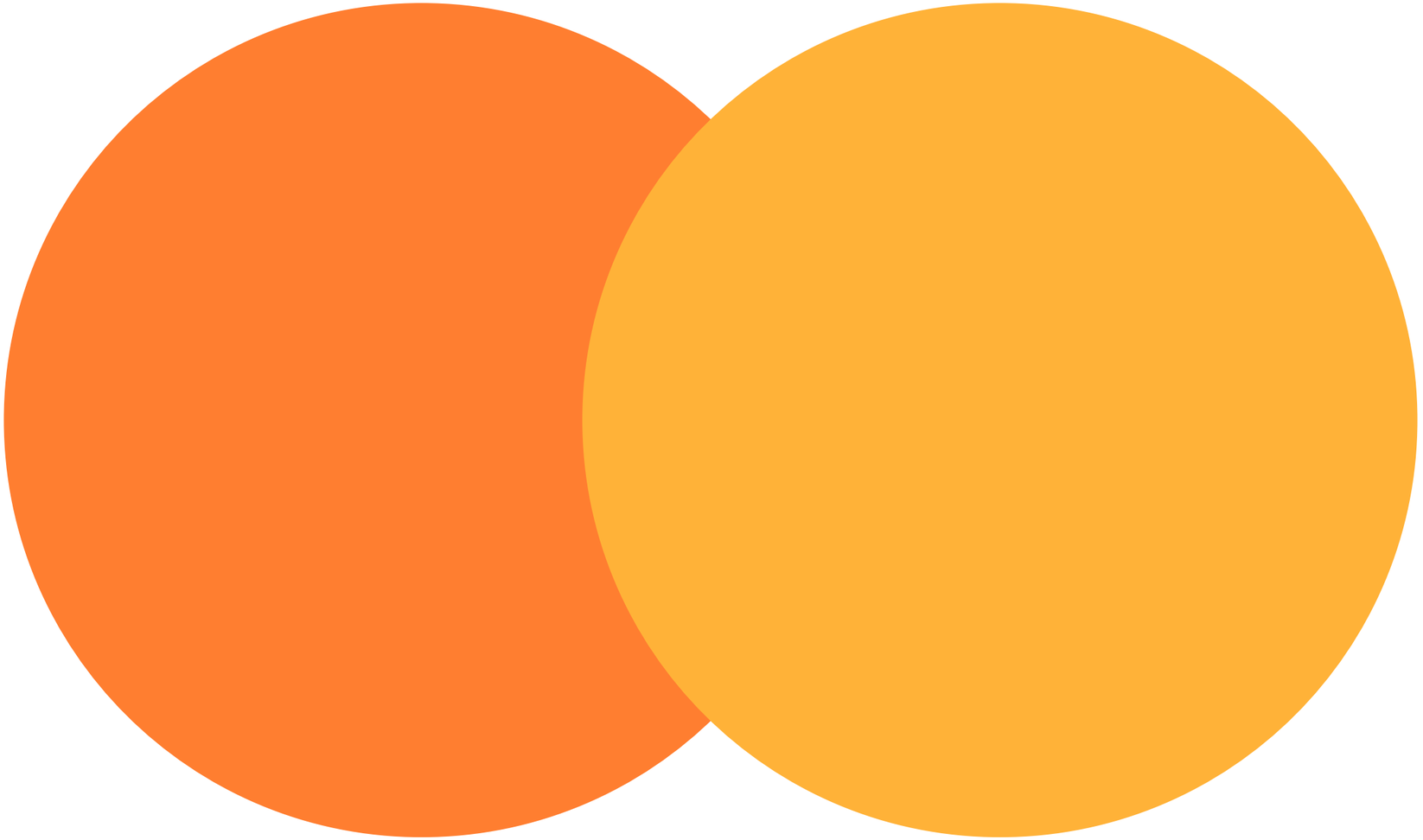

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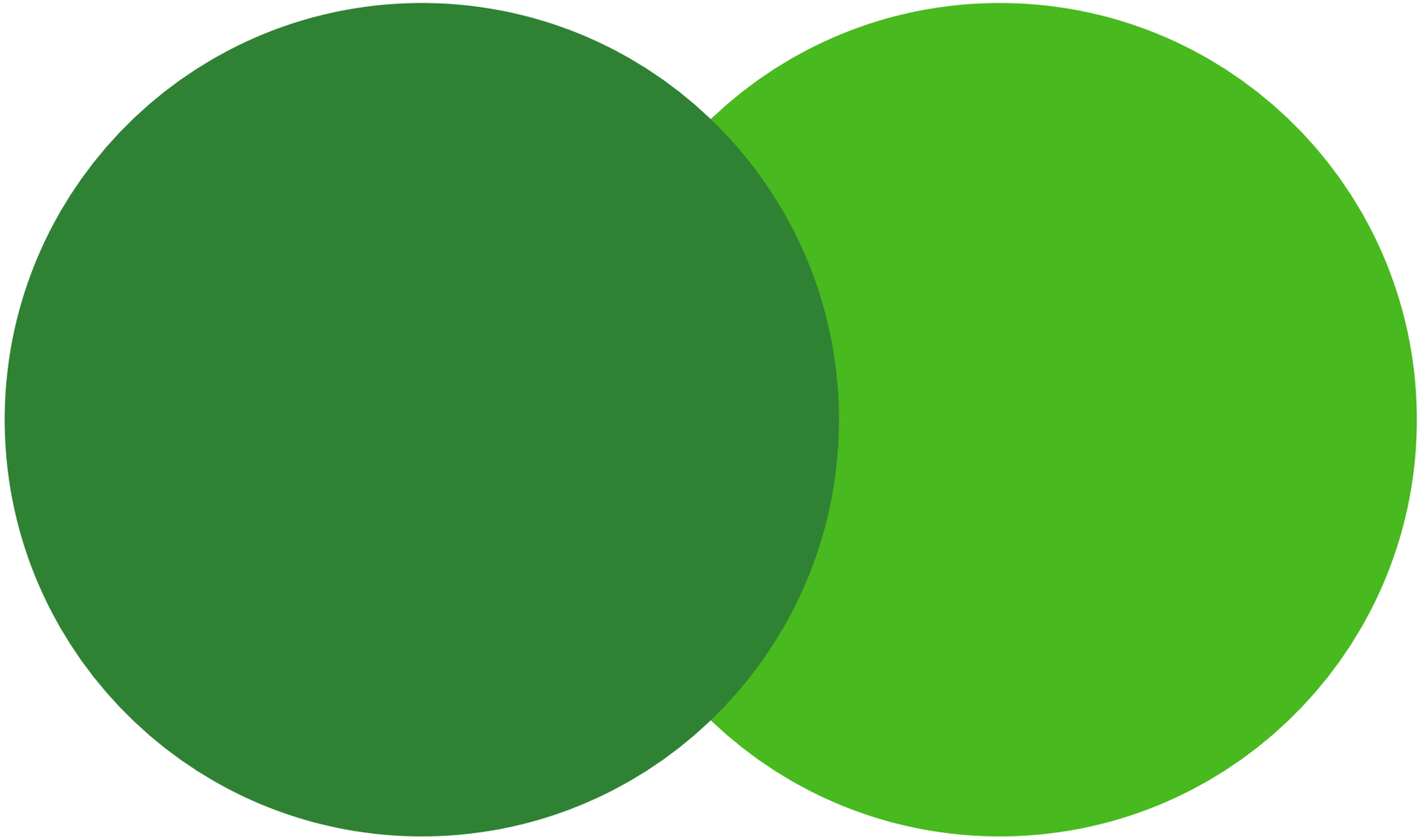

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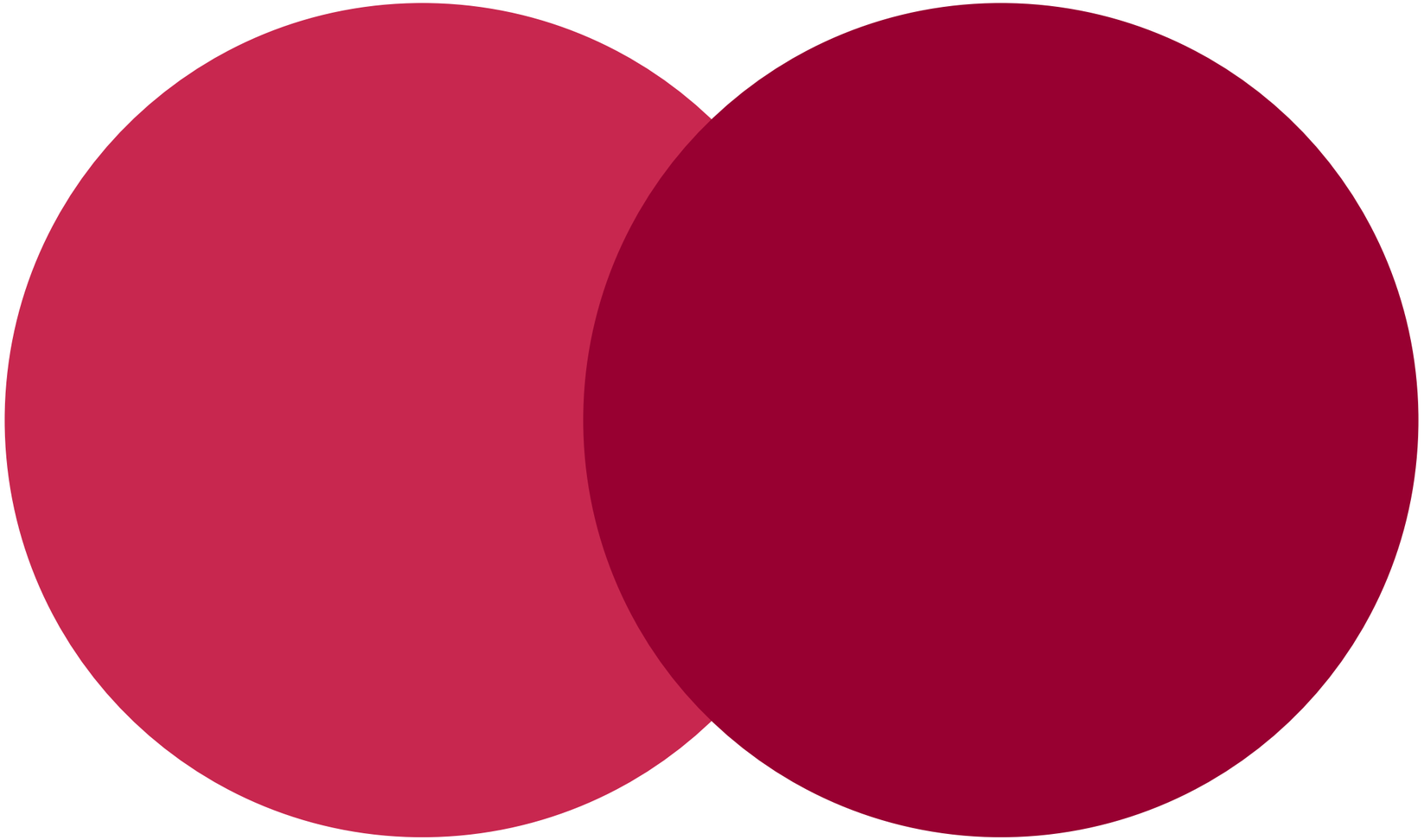
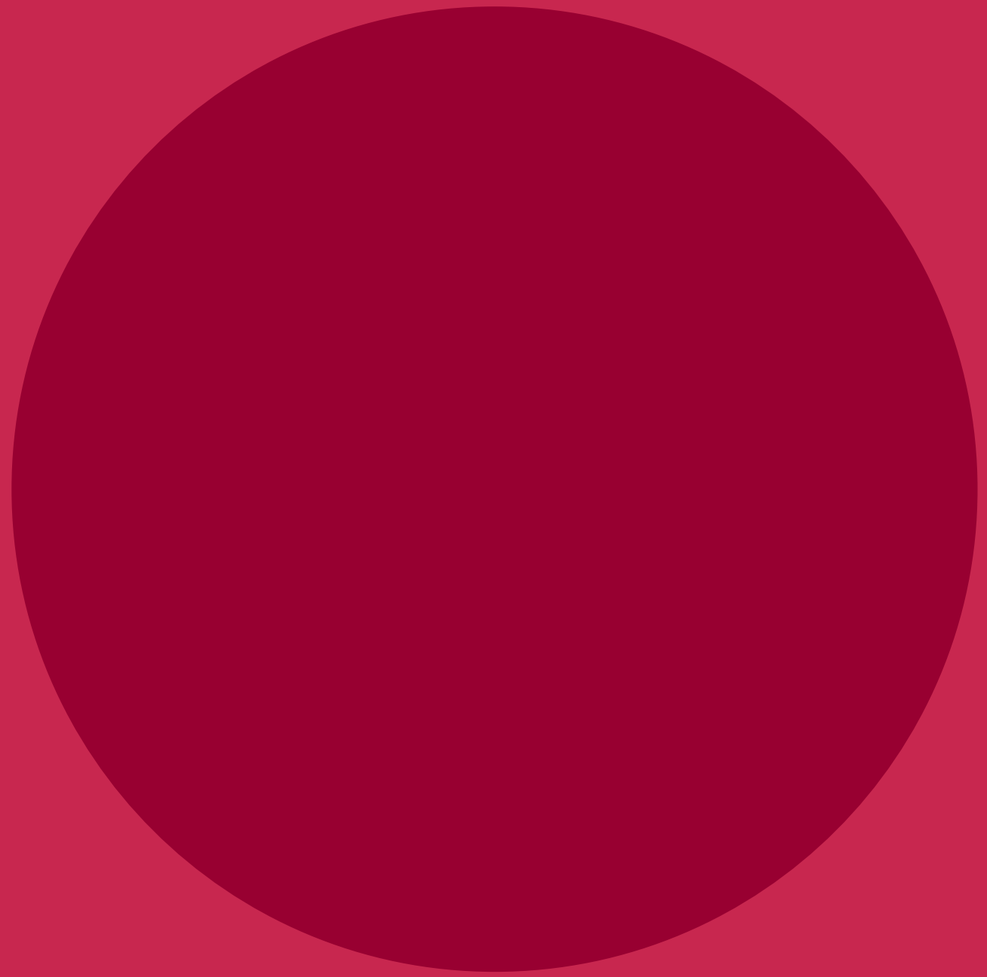
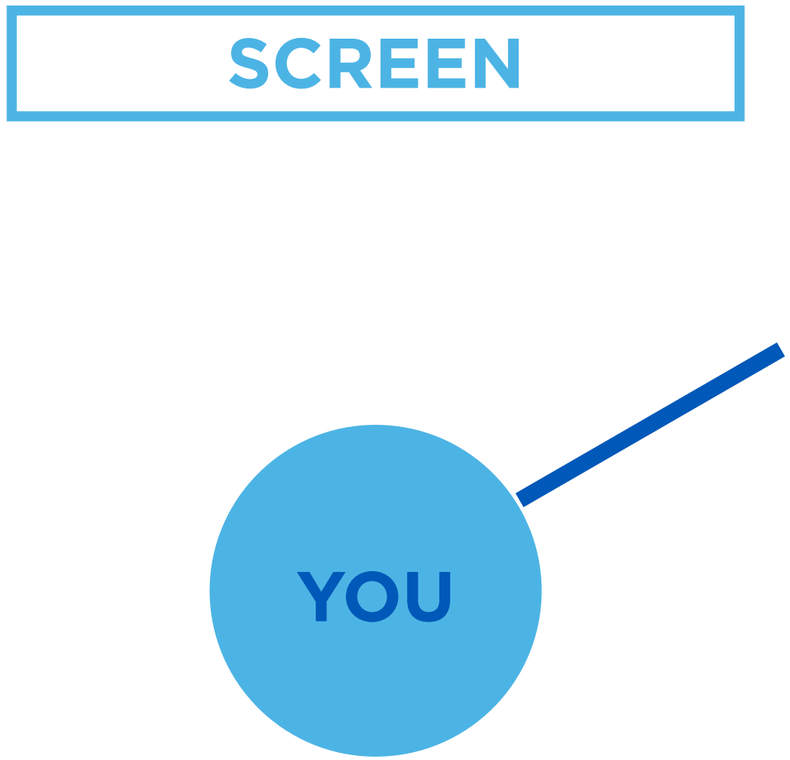


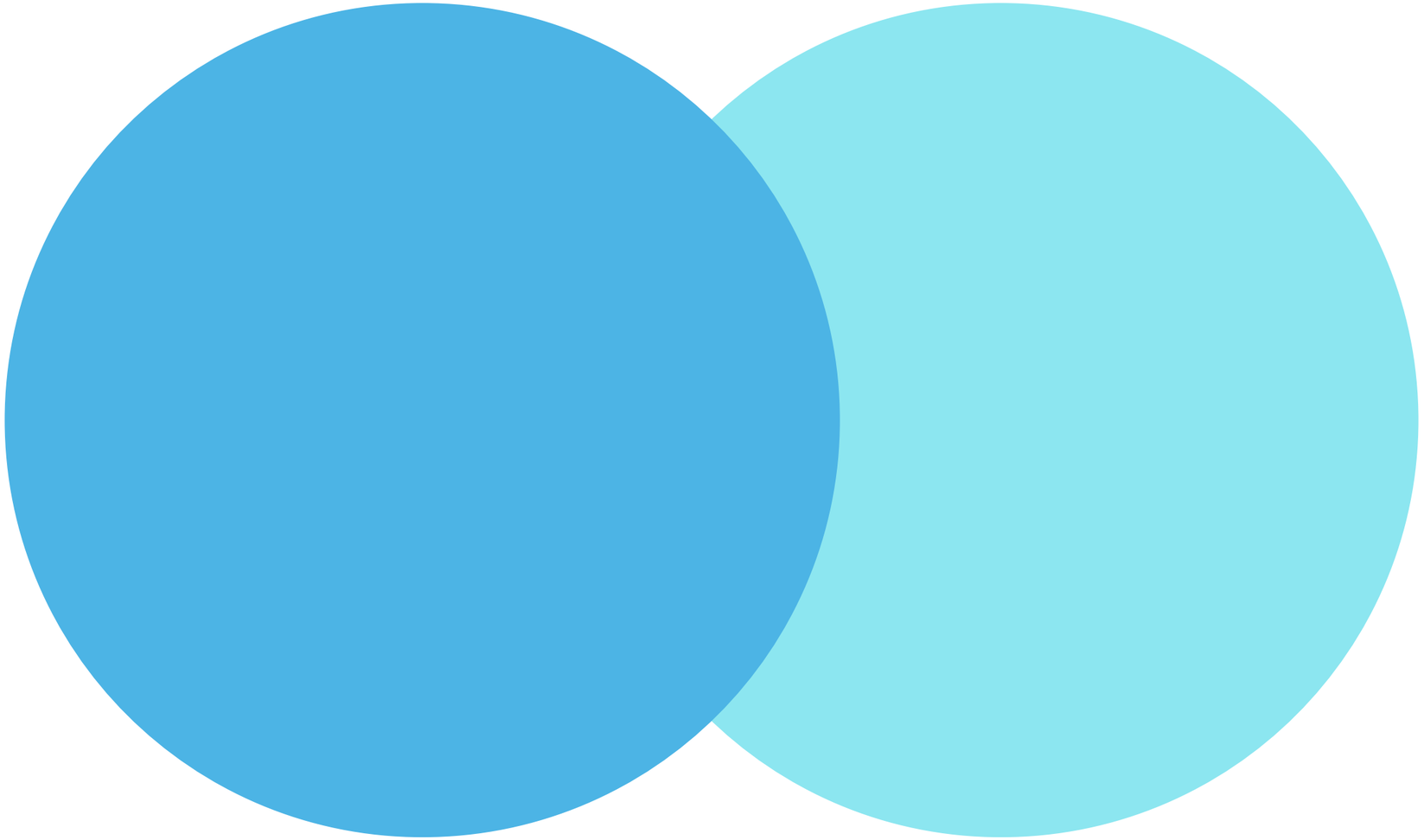


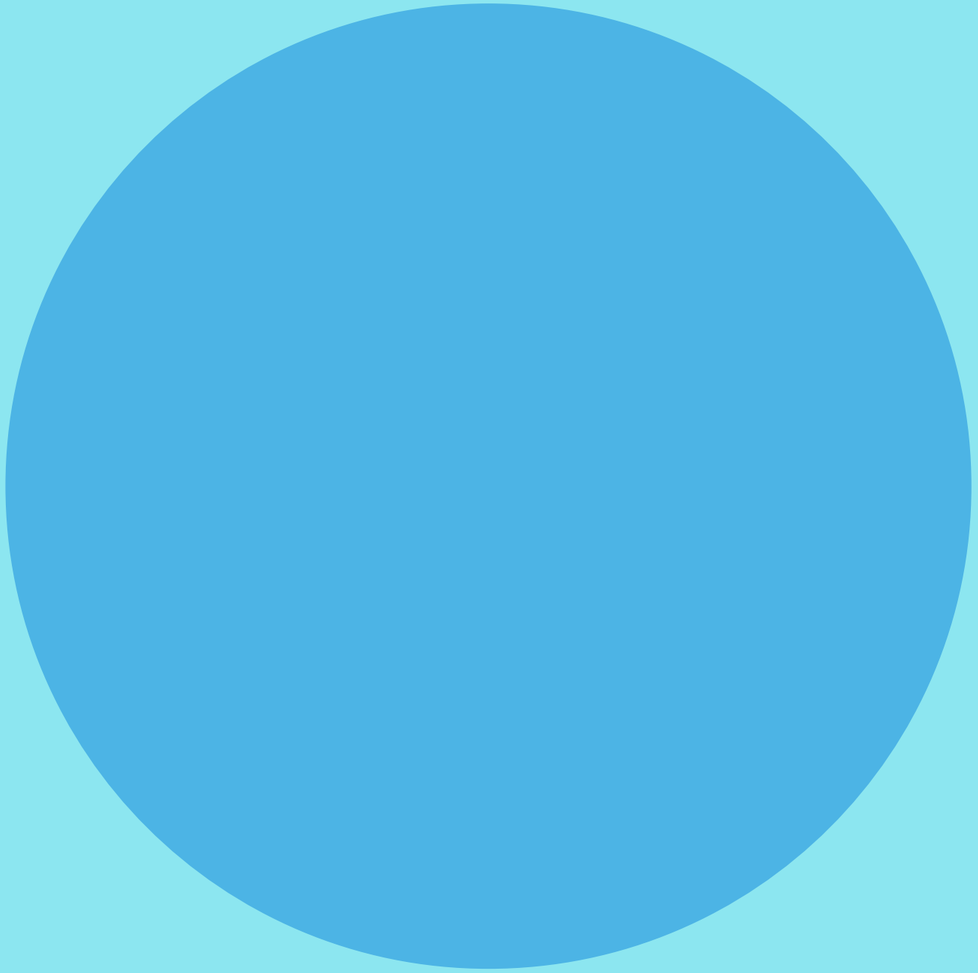
ON TO SET THREE!



For the next set of colored circles, turn your body, head, and gaze an additional 30 degrees to the right. Answer the questions while not looking directly at the screen.

1





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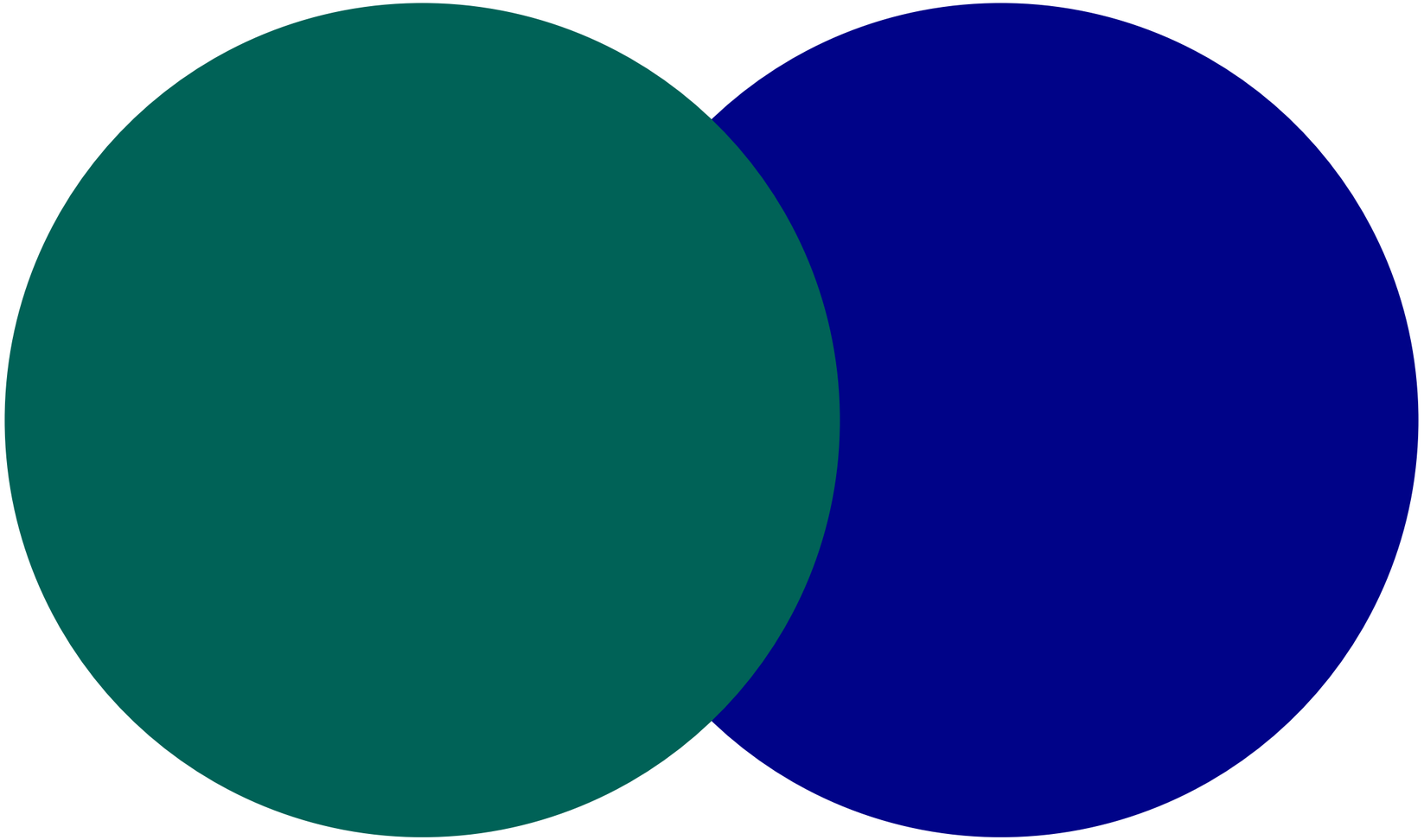

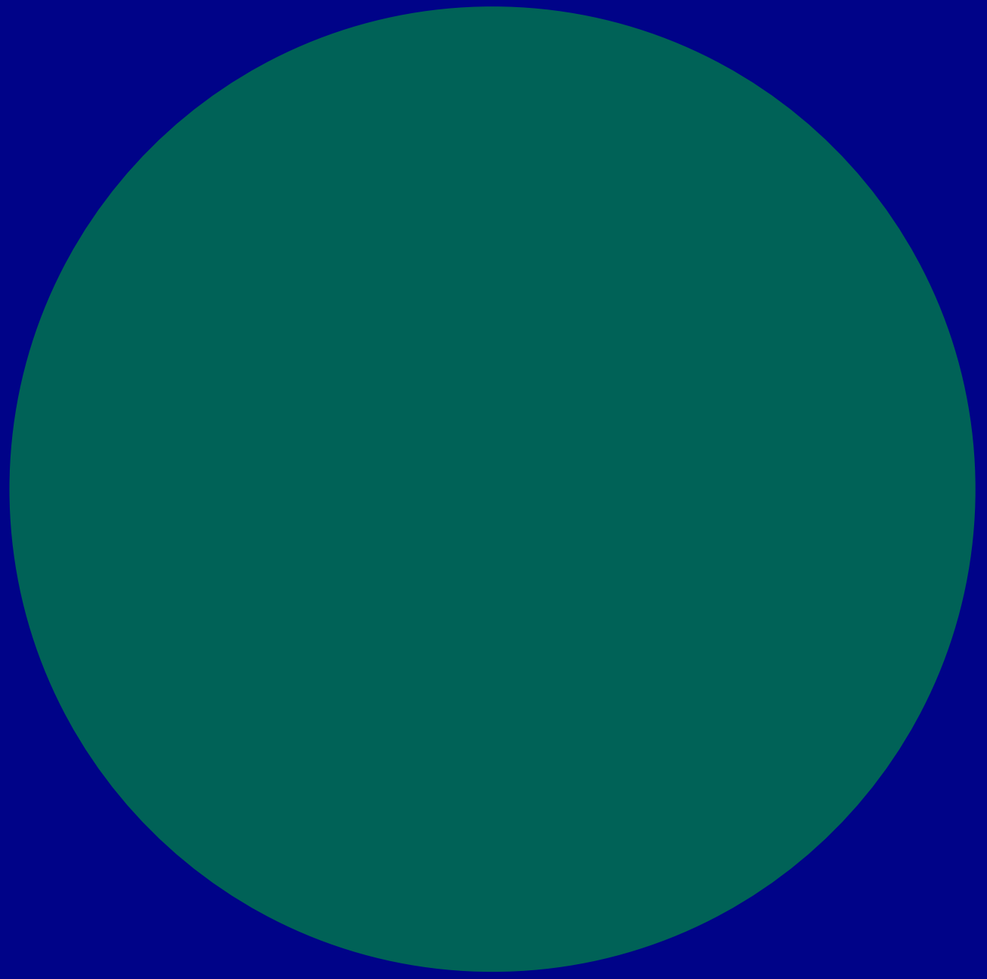

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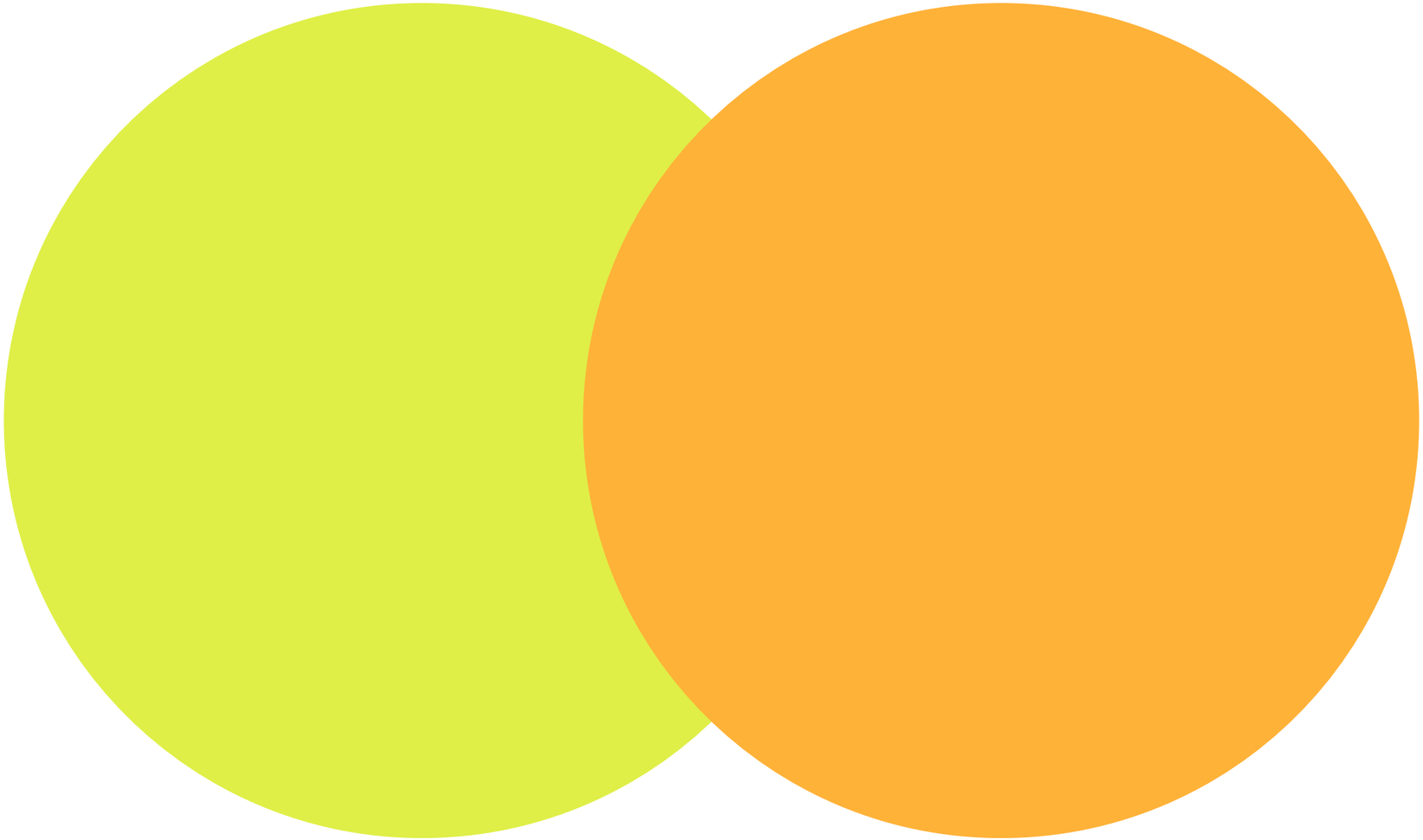

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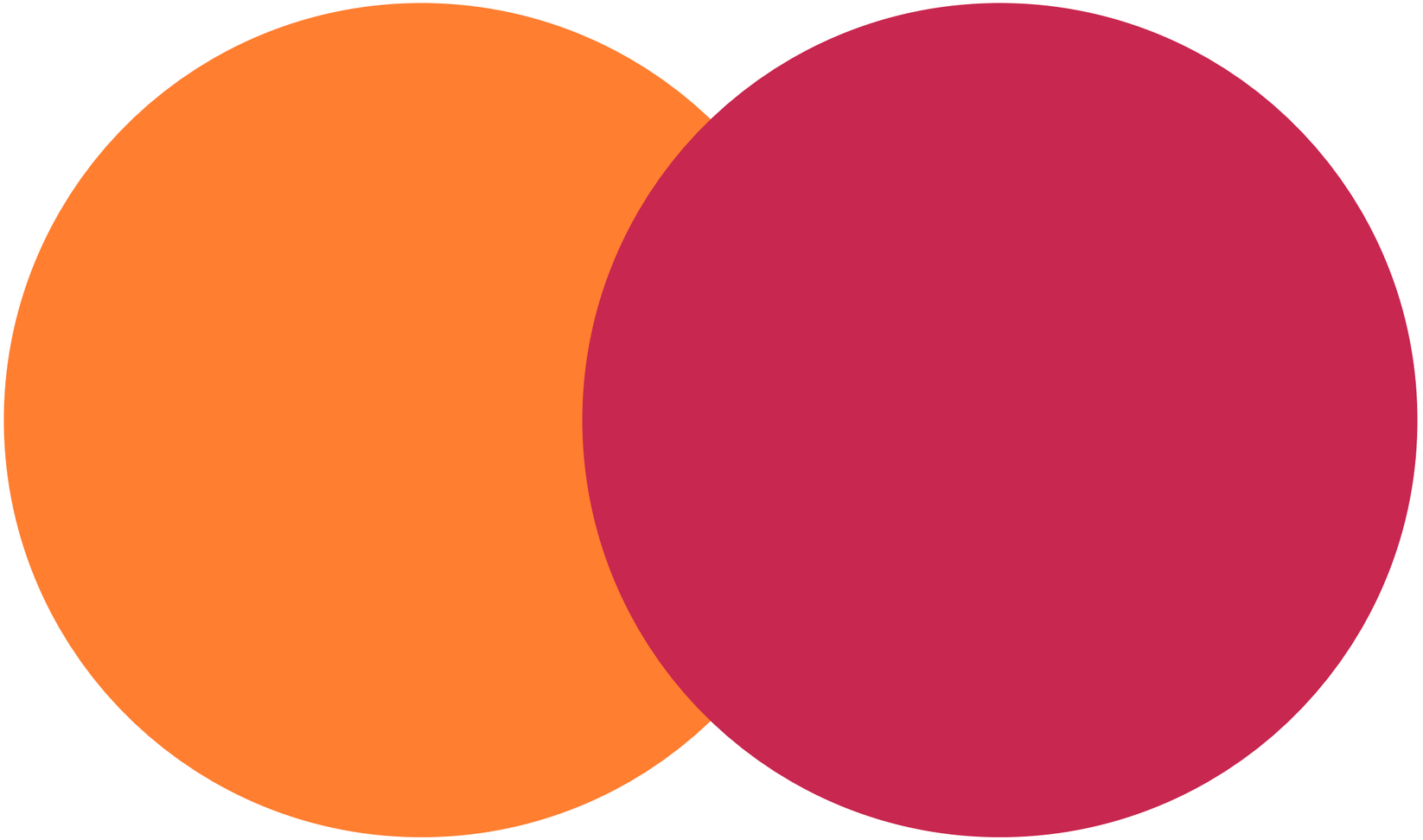

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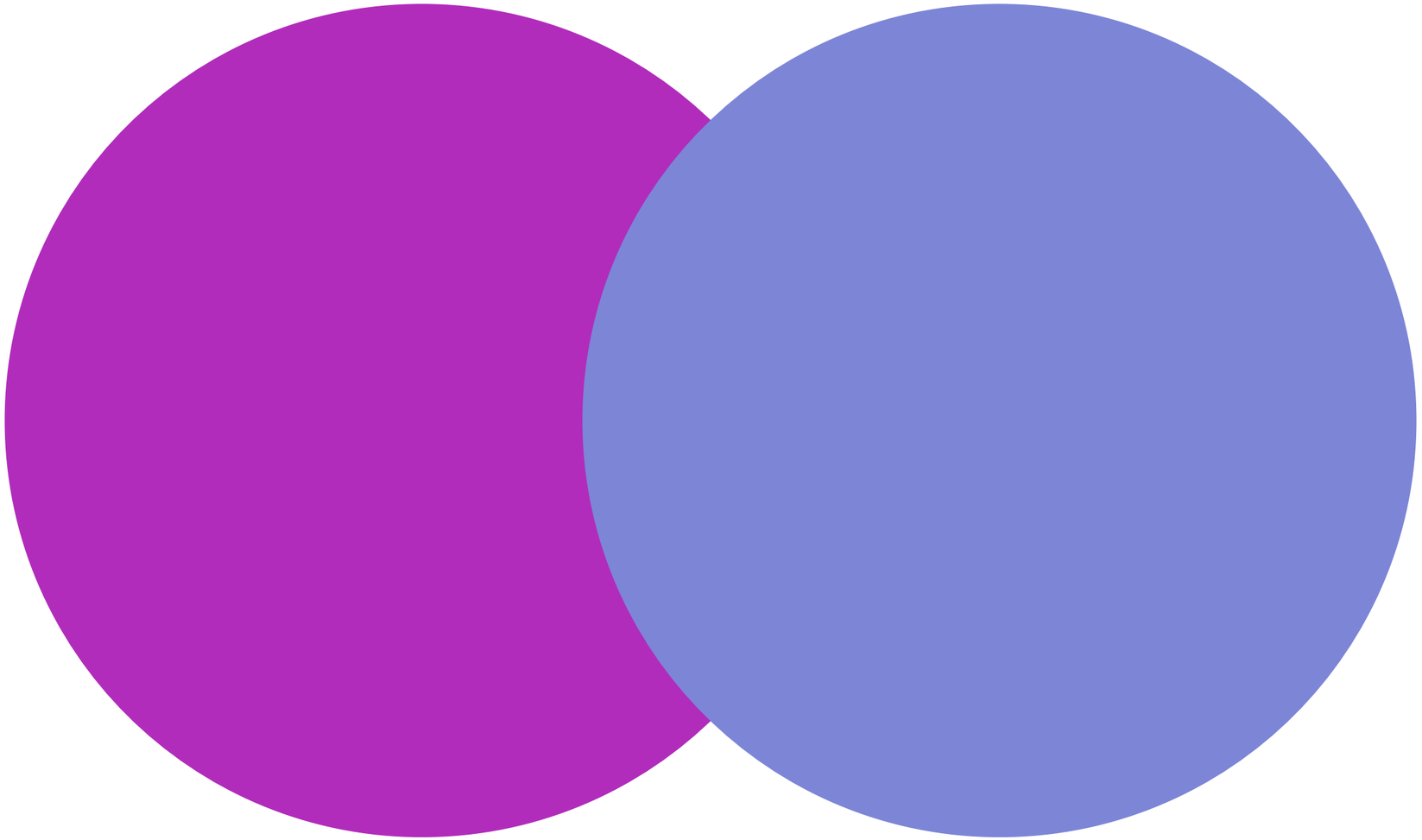
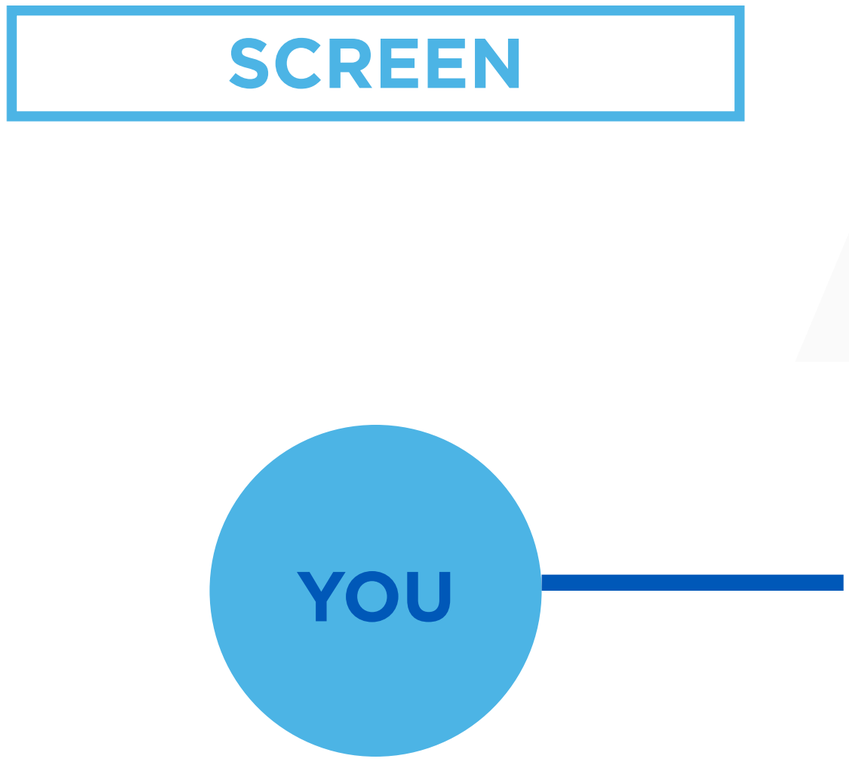
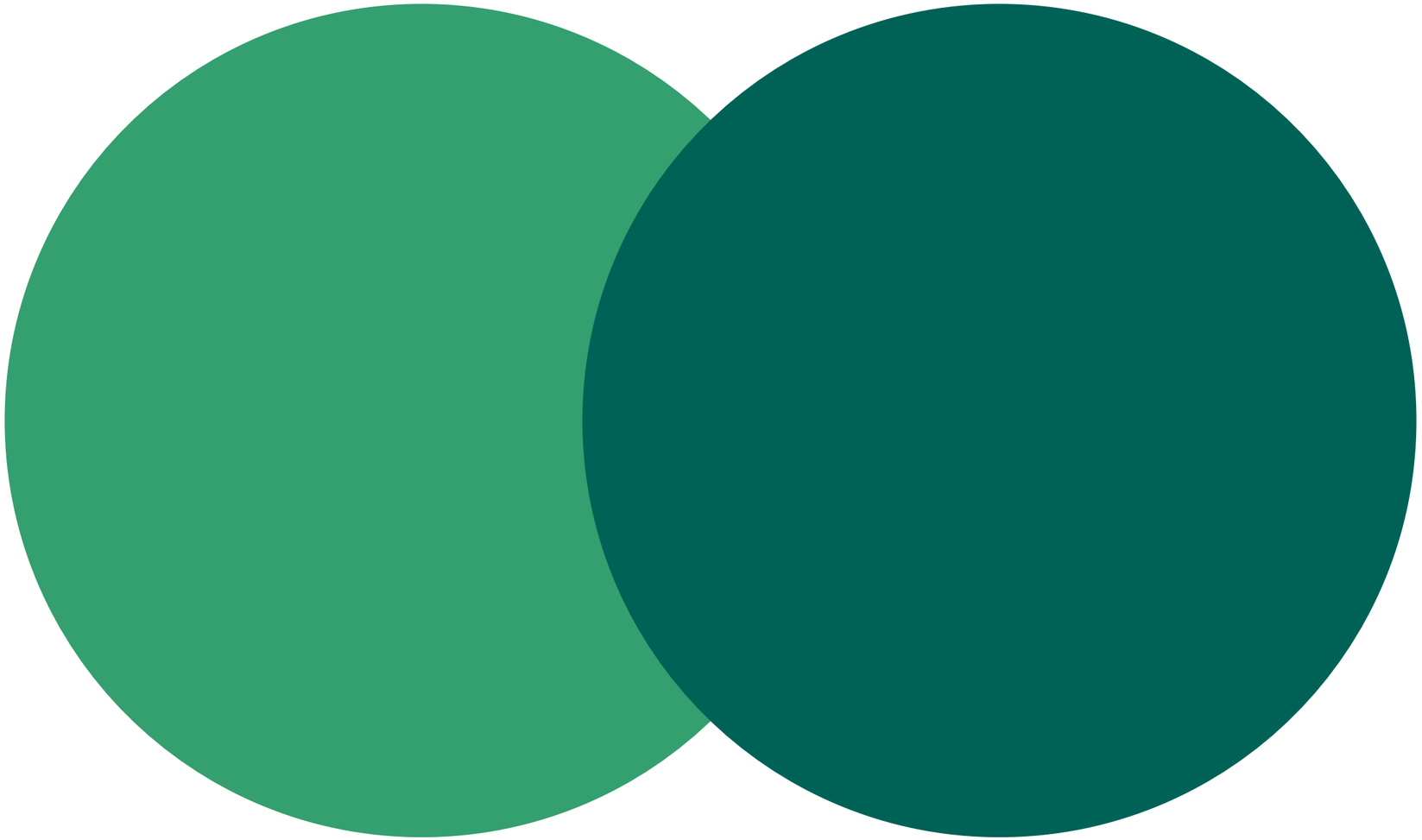


LAST SET!



For the last set of colored circles, turn your body, head, and gaze an additional 30 degrees to the right. Answer the questions while not looking directly at the screen.

1



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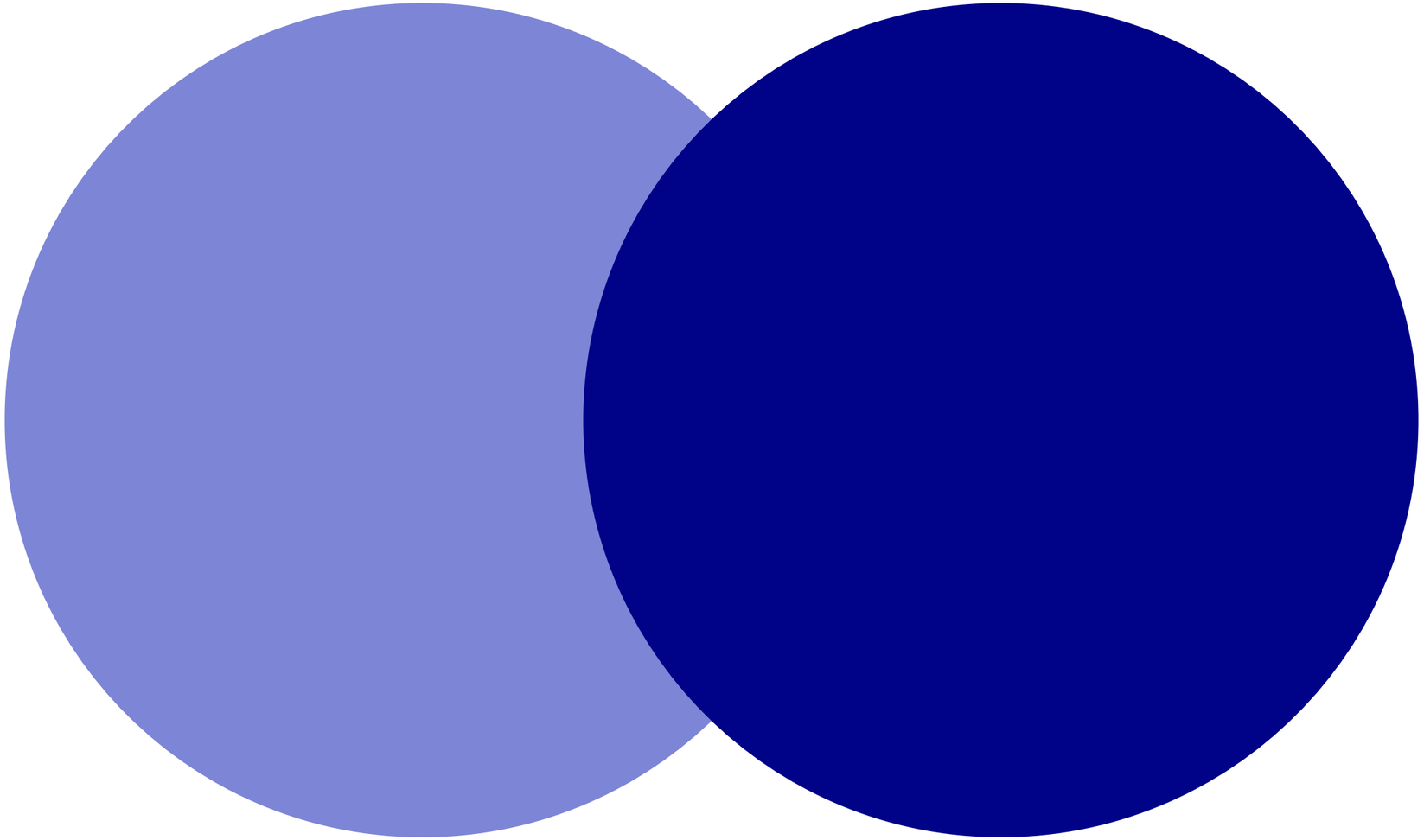

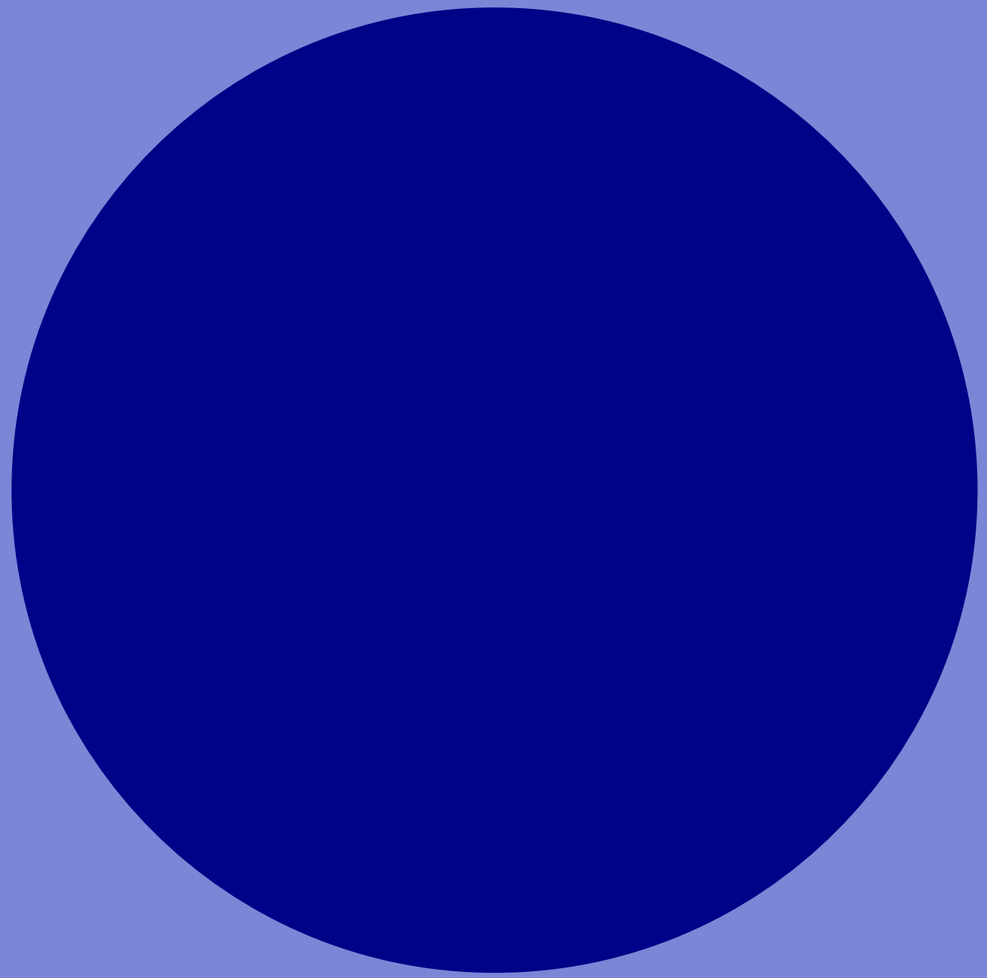

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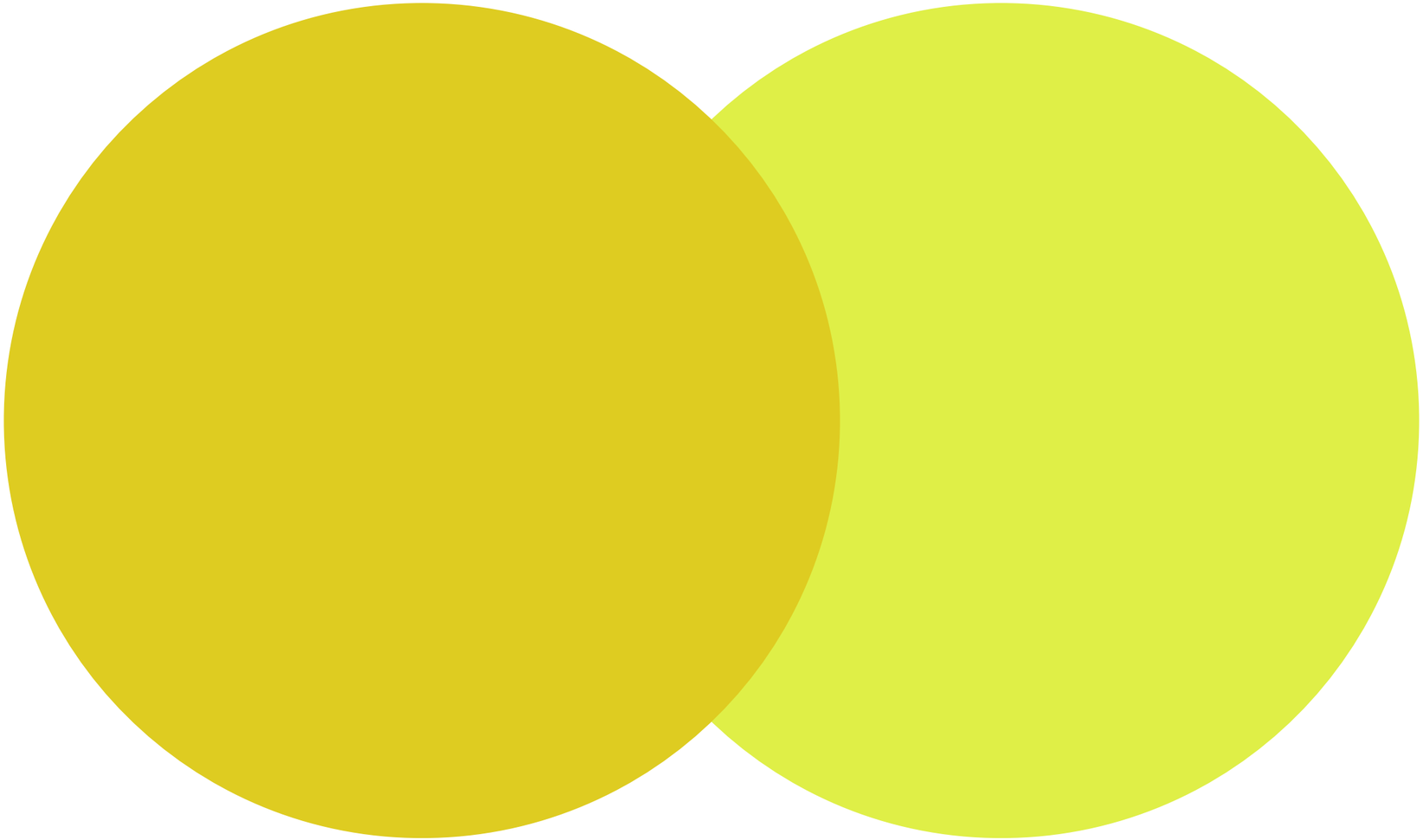

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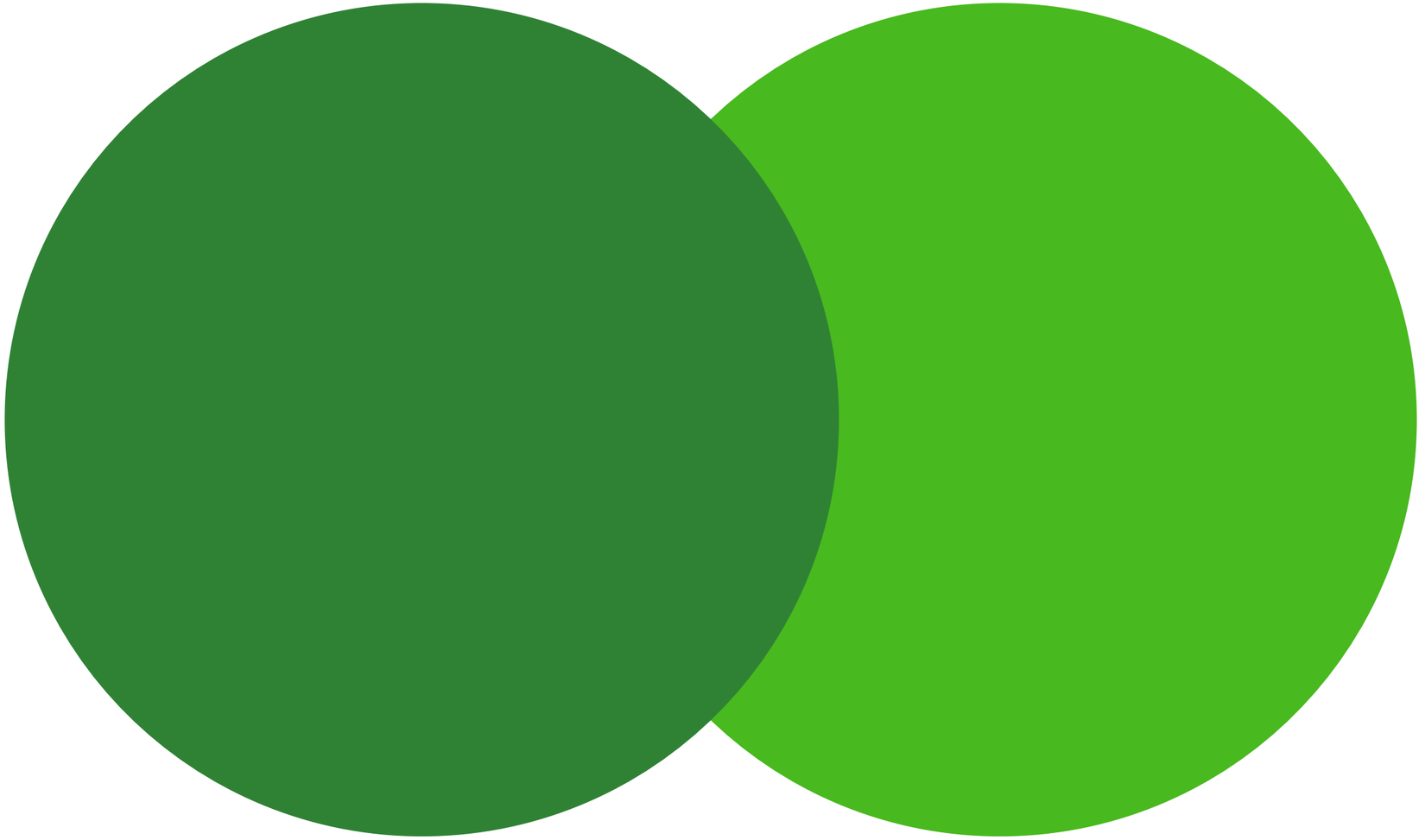

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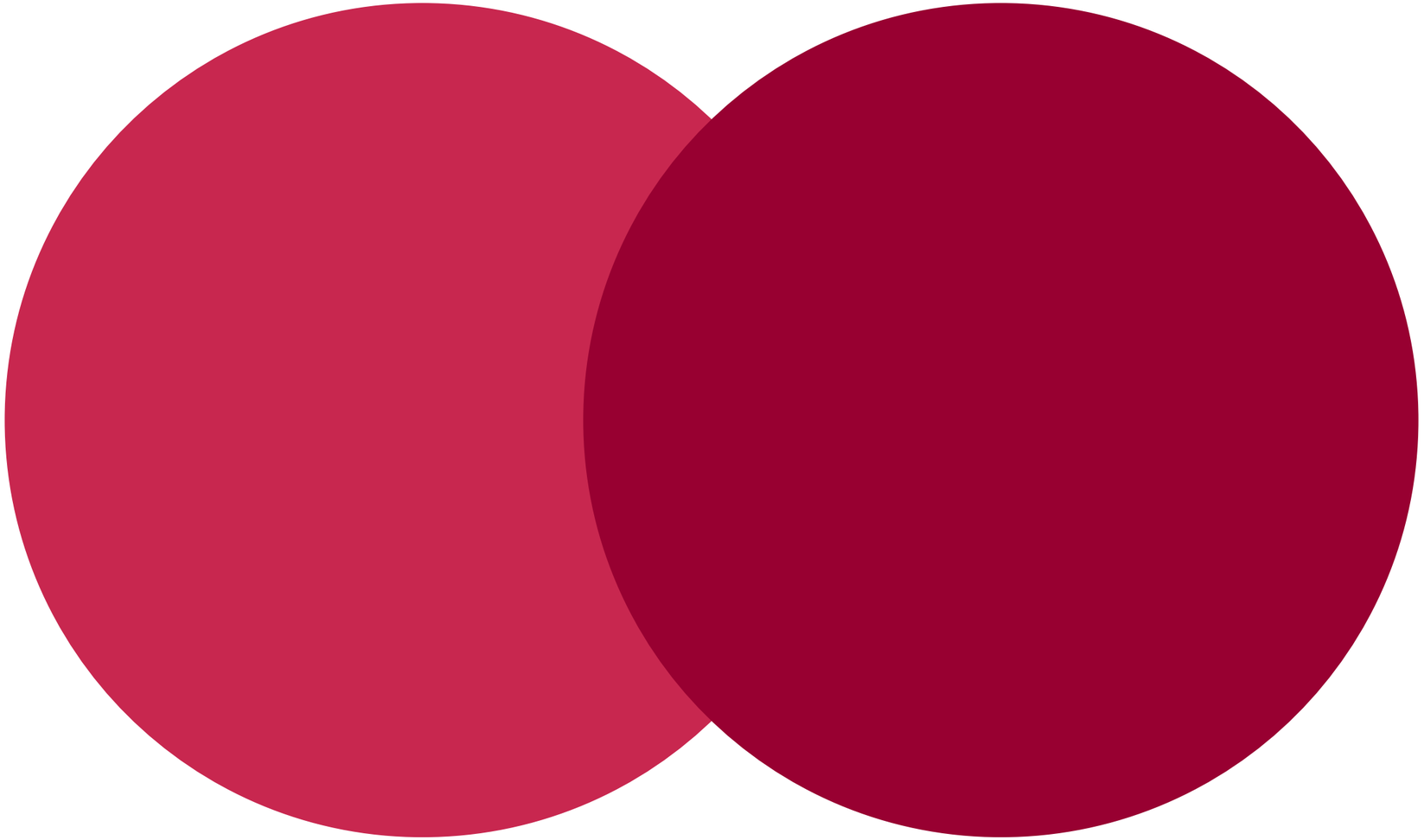
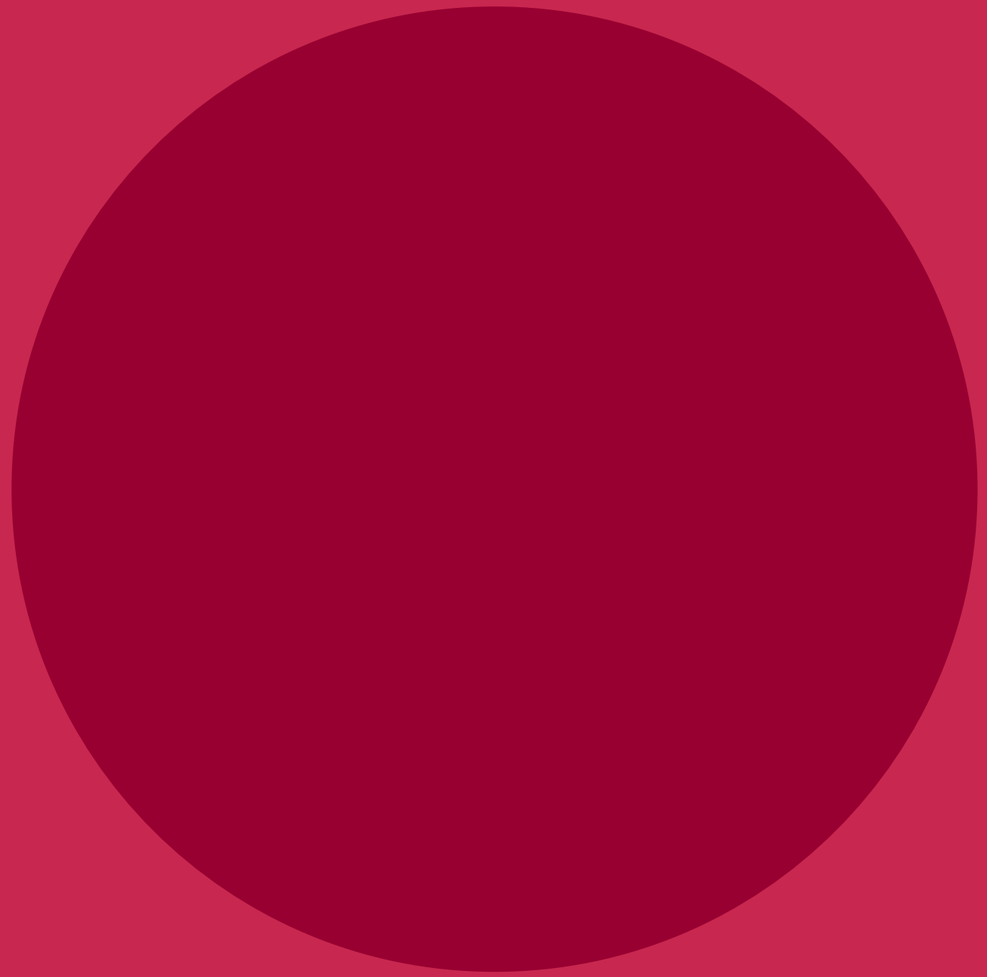




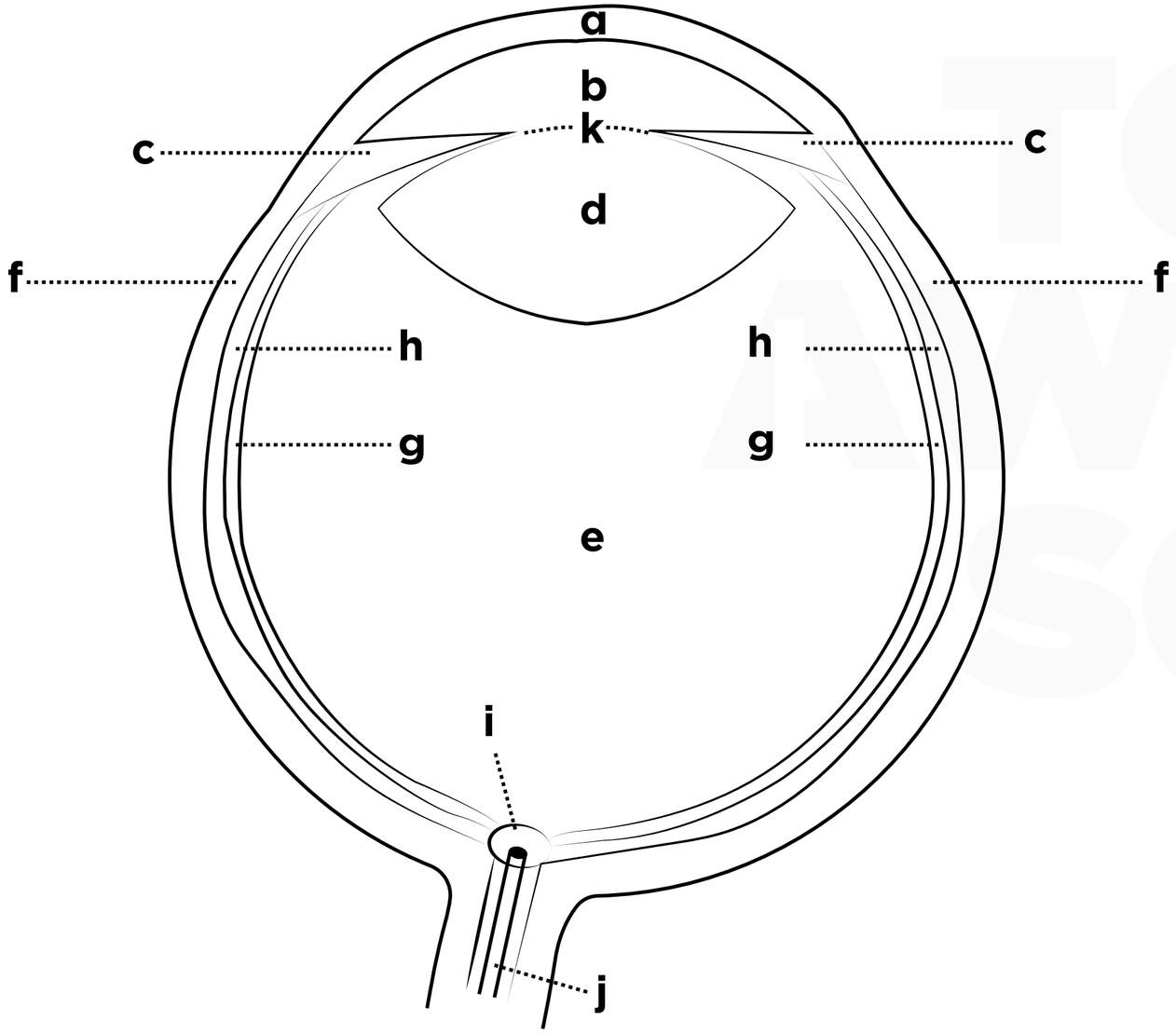
DISCUSSION QUESTIONS

Why were you able to see the circles better when staring directly at the screen?

Why was it harder to identify the circle the farther you turned away from the screen?

How do the colors even reach your eyes?

EYE ANATOMY

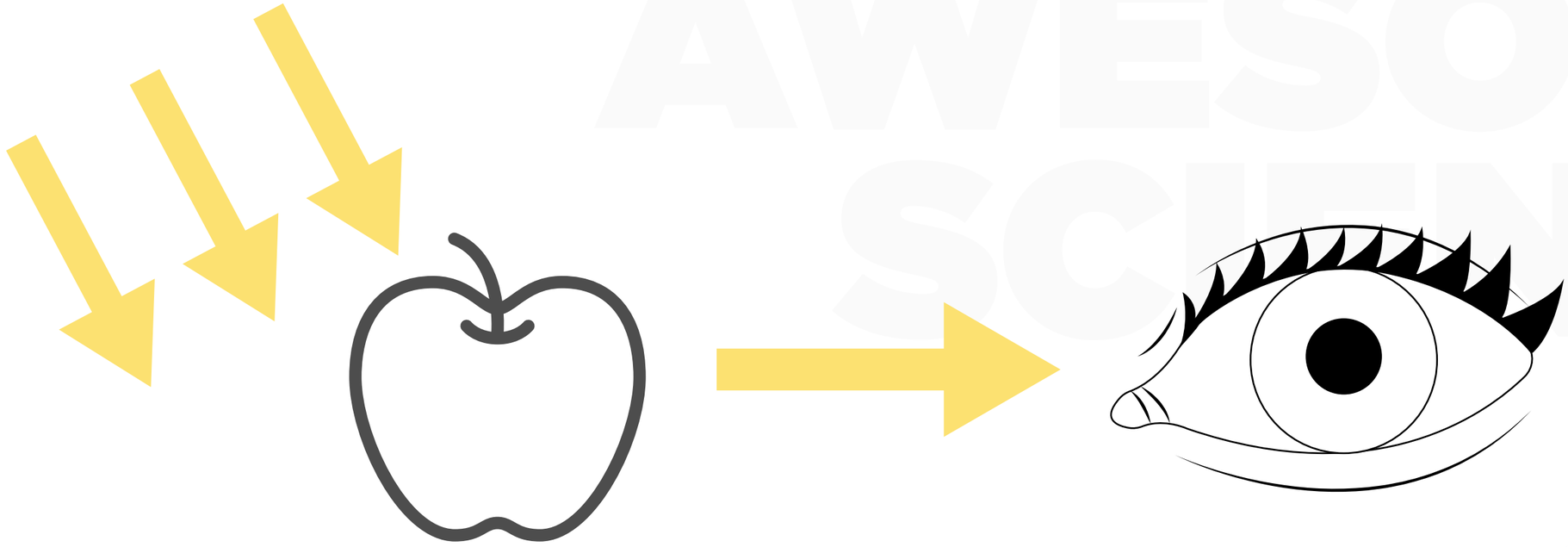


a. Cornea
b. Aqueous Humor
c. Iris
d. Lens
e. Vitreous Humor
f. Sclera
g. Retina
h. Choroid
i. Fovea
j. Optic Nerve
k. Pupil

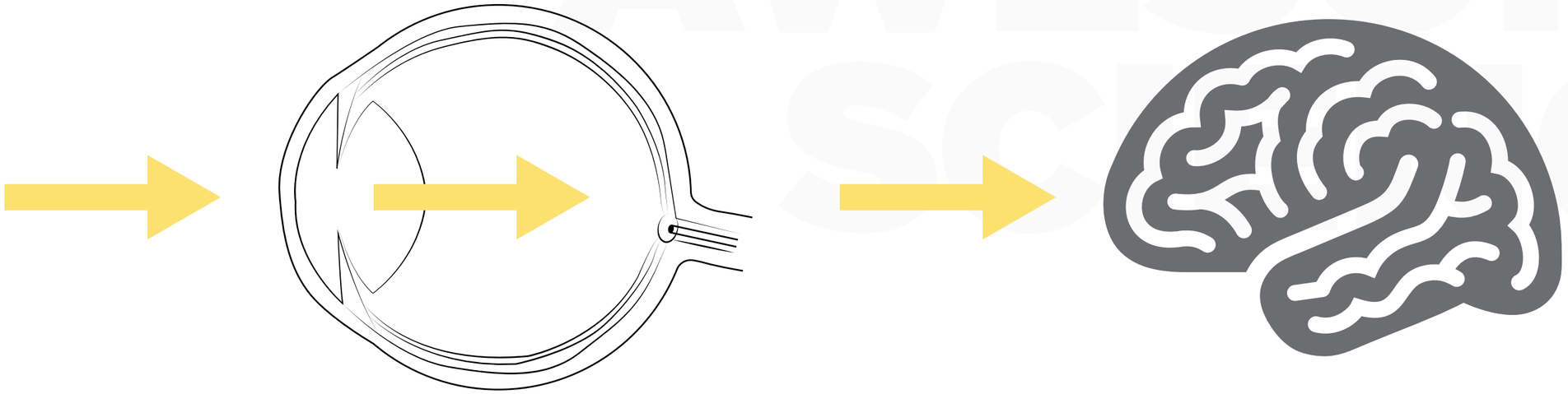
VISION STARTS WITH LIGHT

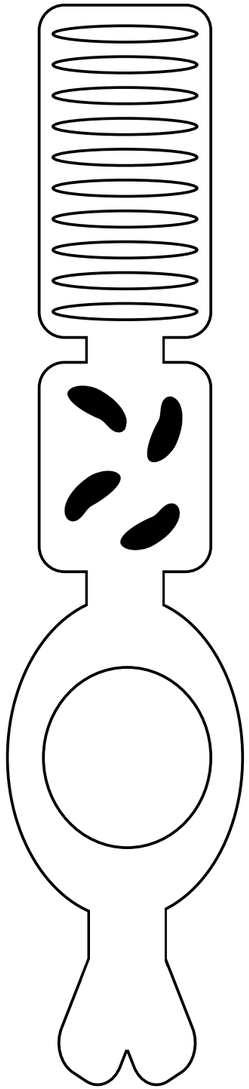
LIGHT REACHES THE EYE

Photons emitted from a light source bounce off of objects and eventually hit your eyes.



Photons pass though the transparent cornea and the lens which refracts and focuses the light onto your retina. The photoreceptors transform the light into electrical signals and nerves carry it to the brain.

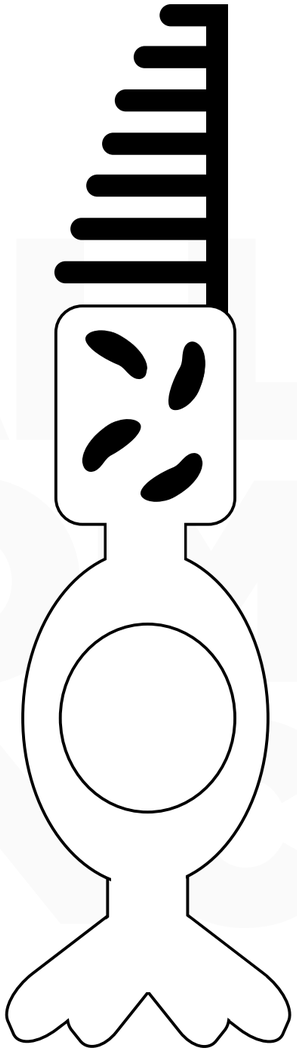


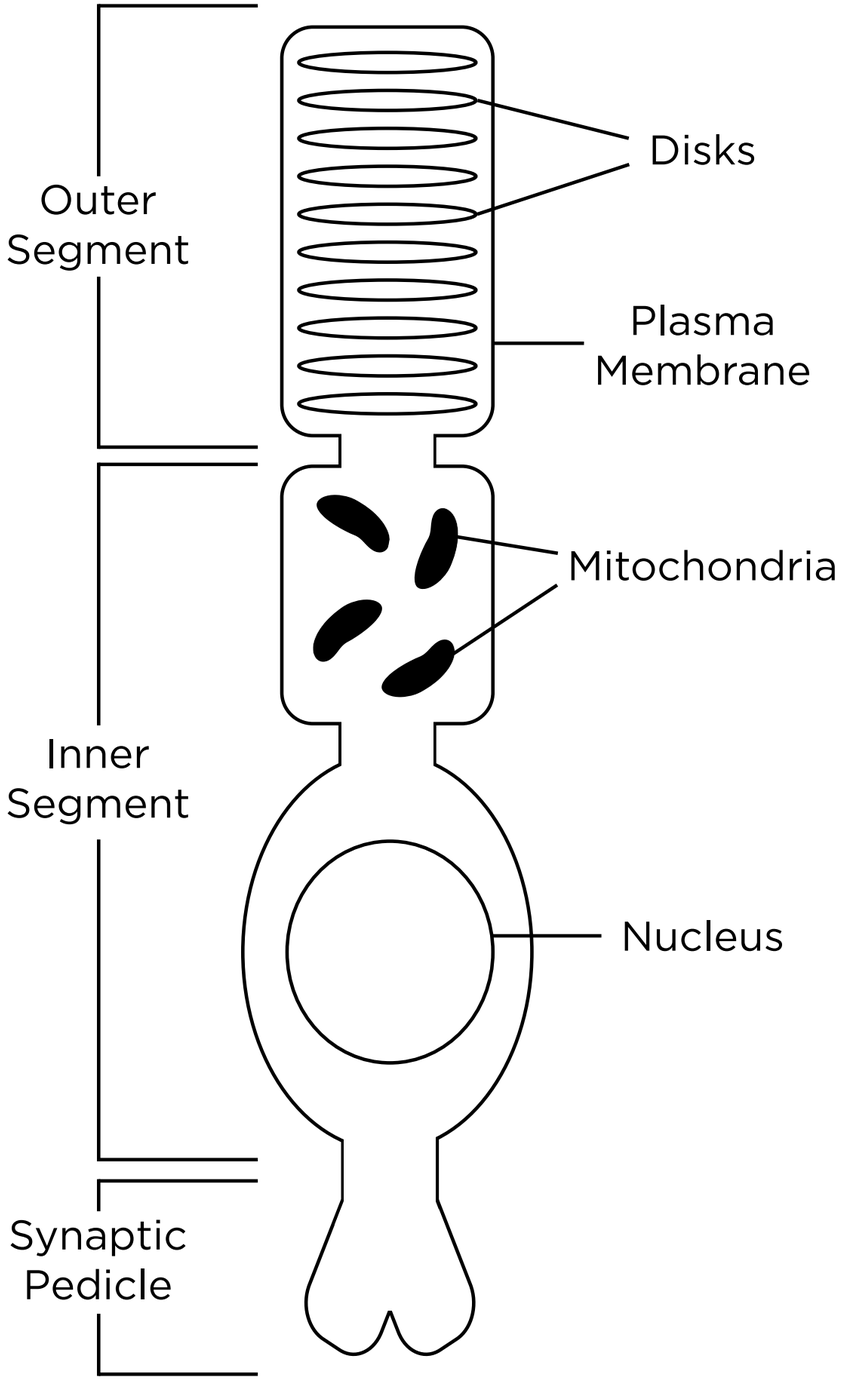


RODS AND CONES

How do your eyes convert light to something your brain can understand? Rods and cones!

Rods and cones are cells that convert light to biochemical signals that are then sent to the brain. They are located in your retina at the back of the eye.

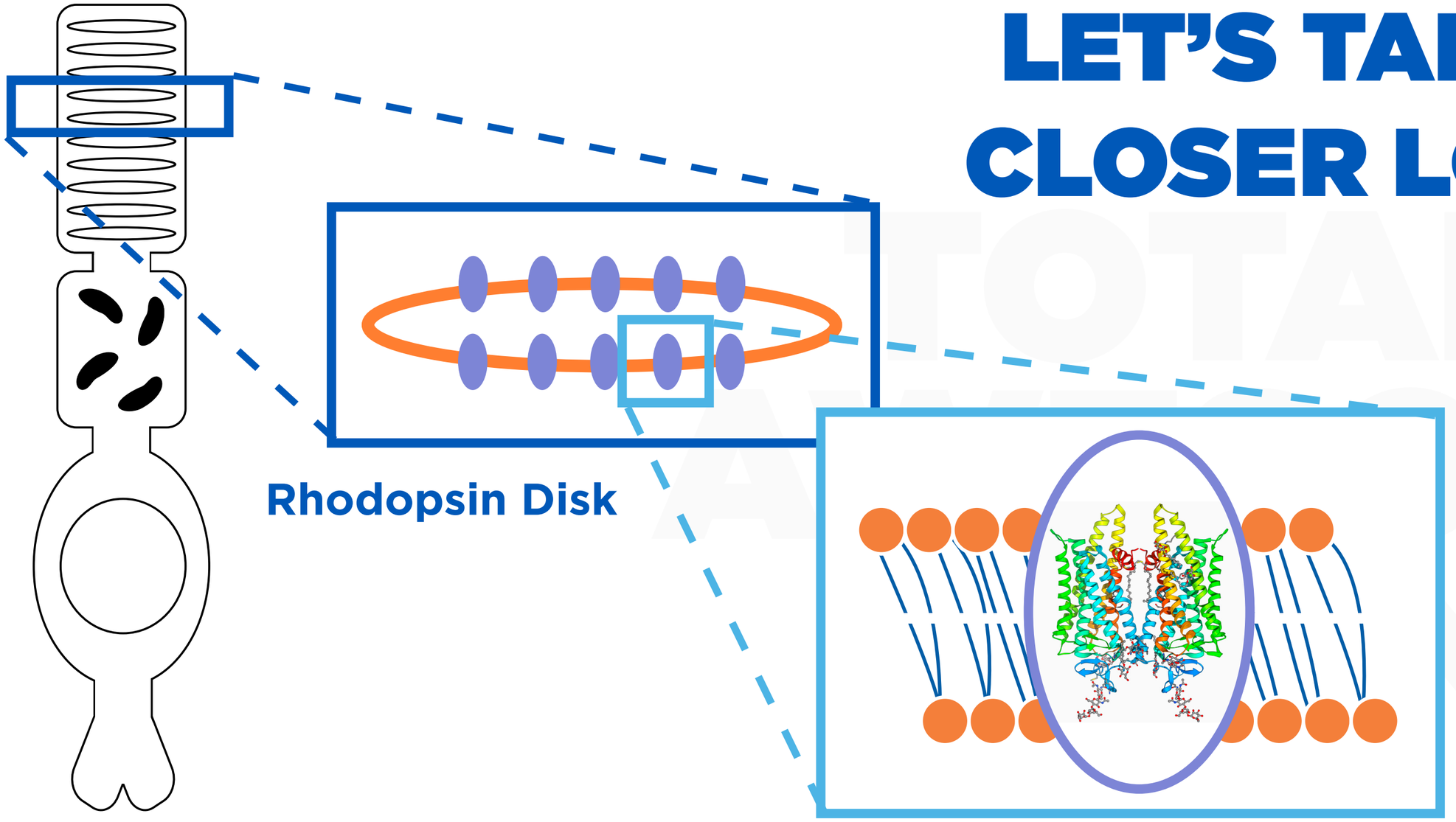




RODS

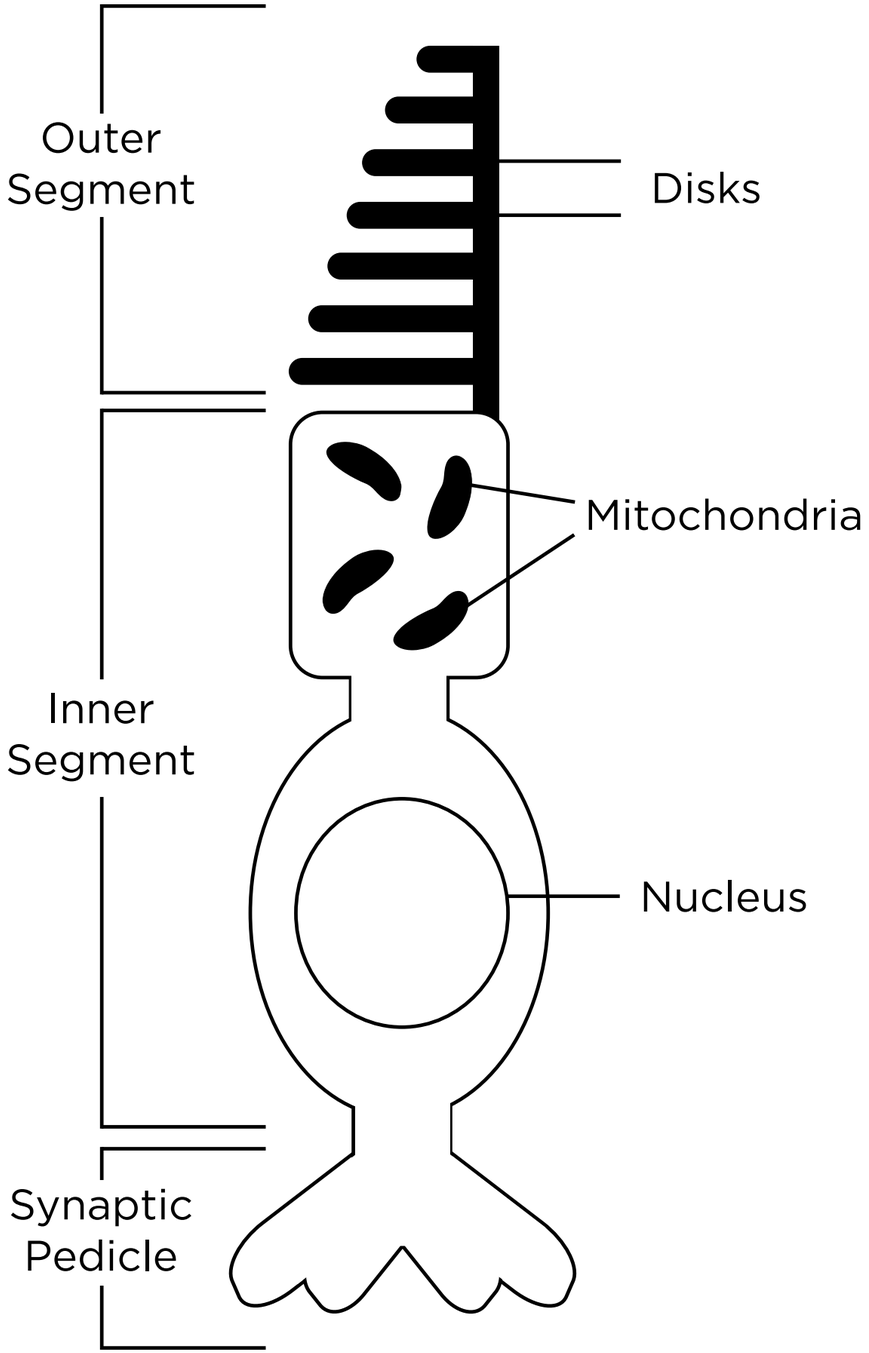
- Sense movement
- Are more abundant than cones: 90 million of them in the average eye
- Work in low light

LET'S TAKE A CLOSER LOOK!



Rhodopsin Disk

Rhodopsin Molecule



CONES

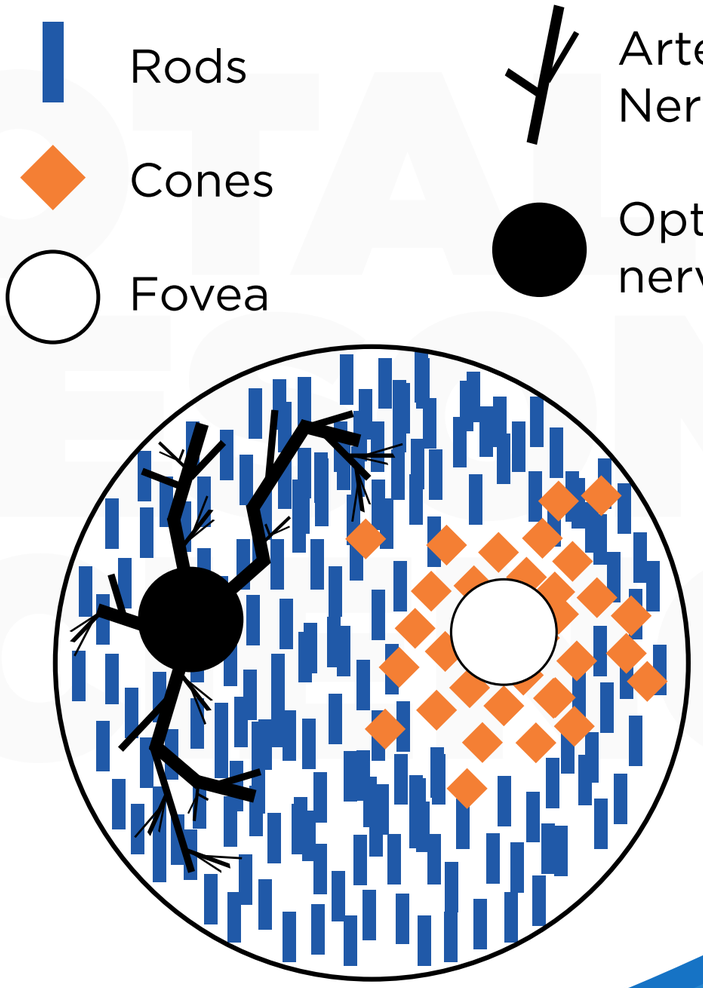
- High color acuity and focus very well in bright conditions.
- Less numerous than cones - around 4.5 million per eye.
- Concentrated around the Fovea (dimple on the center of the retina).

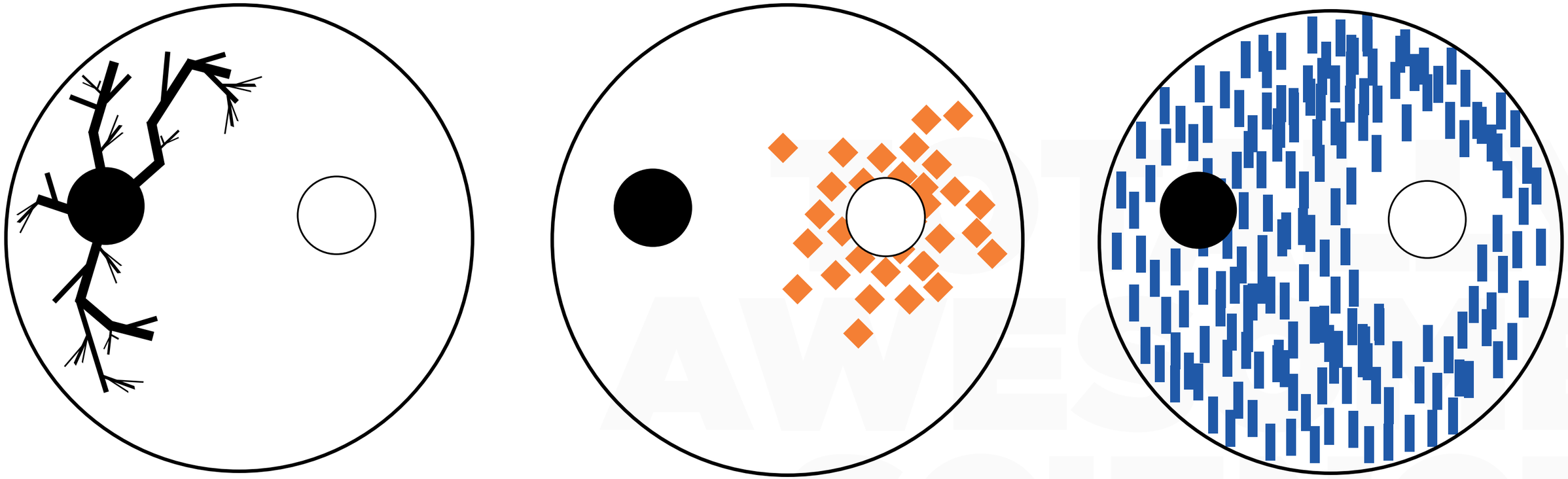
WHERE ARE RODS & CONES?

Rods and cones are found in the back of the eye (retina). The optic disk/ nerve and fovea are also in the retina.

Optic disk/nerve has neither rods nor cones. It is full of nerves traveling signaling the brain and arteries suppling blood and nutrients.

Fovea is the focal spot for most of the light entering your eye. It consists of roughly 30K specialized cones that are slightly smaller than other cones.





Rods

Cones

Fovea

Arteries & Nerves

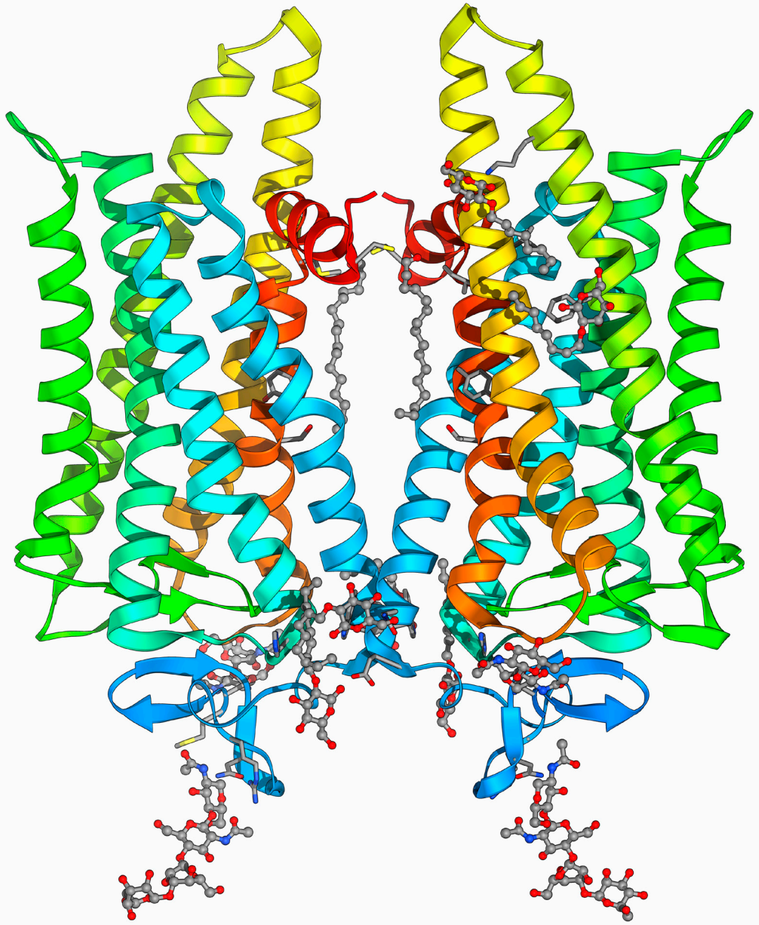
Optic disk/ nerve

TRANSFORMING LIGHT

Rods and cones transform light into electrical signals through ***phototransduction*** (process of getting signals from eye to brain):

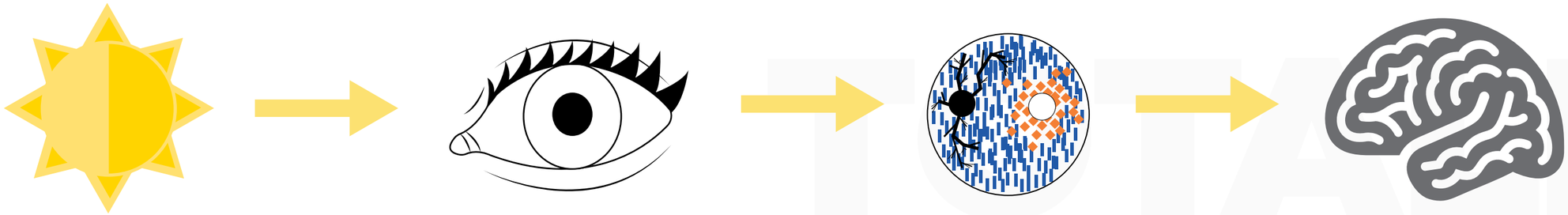
1. Rods or cones capture light.
2. Opsins (specialized proteins) turn the captured photons into electrochemical signals.
3. The optic nerve sends signals to the brain.

TRANSFORMING LIGHT



The human vision has 4 essential types of opsin:
1 for the rod
3 for the cones

TRANSFORMING LIGHT



- In your photoreceptors (rods and cones), opsins are coupled with Vitamin A.
- Vitamin A acts as light absorbing molecule. After absorbing light, its molecular structure changes and separates from the opsin.
- As the separation occurs, an electrical signal is generated by opsin in a very complex biochemical process known as ***the visual cycle***.

EXPERIMENT TIME!

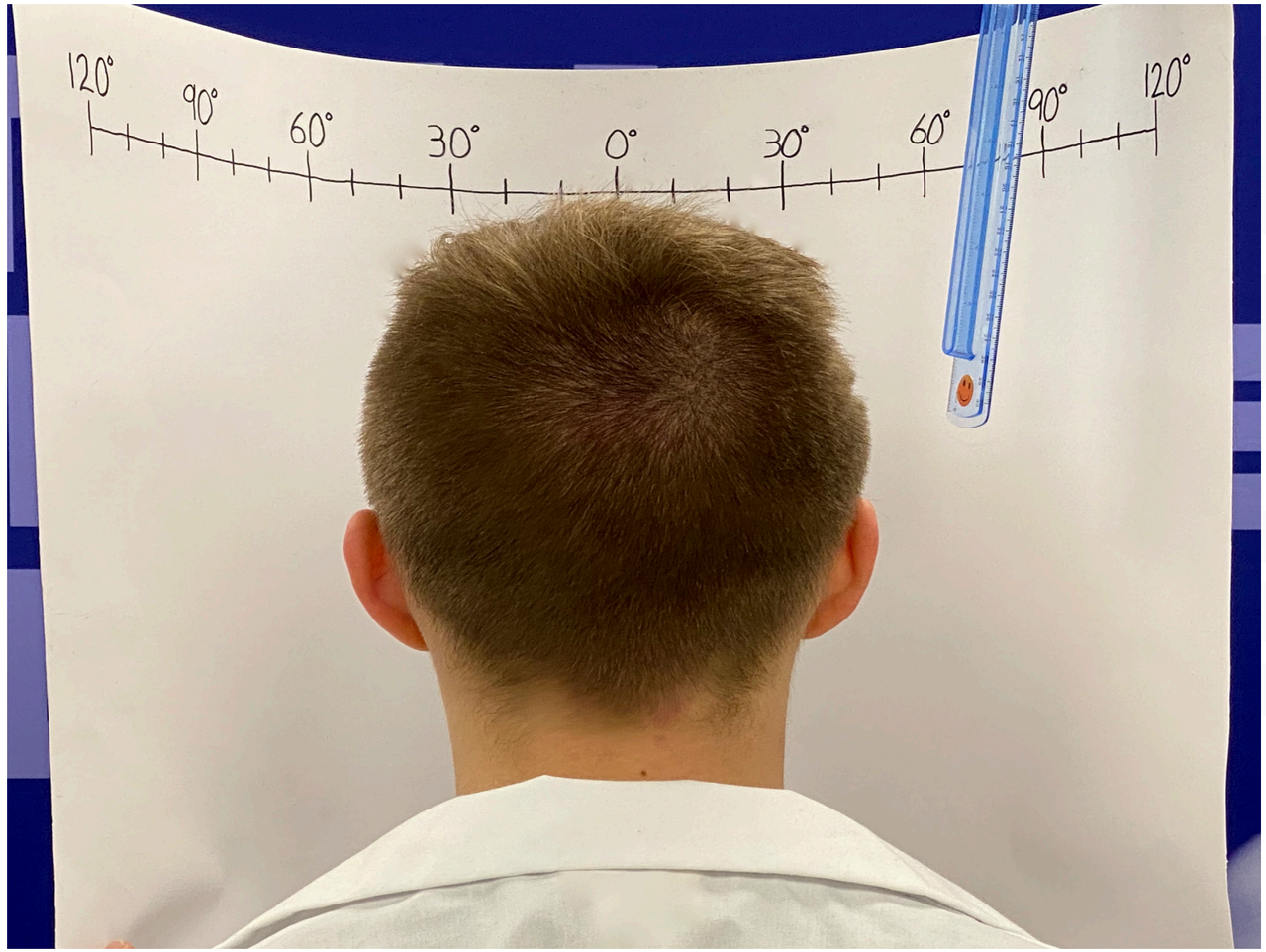
What you need:

- Markers
- Construction paper
- Yard stick
- Large sheet of paper (2.5 ft X 2 ft)
- Clips and ring stand

Before you begin:

- Make your poster board using the instructions in the lab notebook.
- Make your sticks using the instructions in the lab notebook.

EXPERIMENT TIME!



The test subject will hold the poster board in front of them while bending it around their face, so that the ends line up with their ears and rests a foot away from their face. Their eyes should be level with the fixation point. They should focus on the black dot in front of them.

EXPERIMENT TIME!

The experimenter will choose one of the sticks without telling the test subject. Starting at 120 degrees, the experimenter will slowly move the stick towards 0 degree. Stop when the test subject notices the stick. Make a note of the angle and continue moving the stick until the test subject notices the color. Record the results.

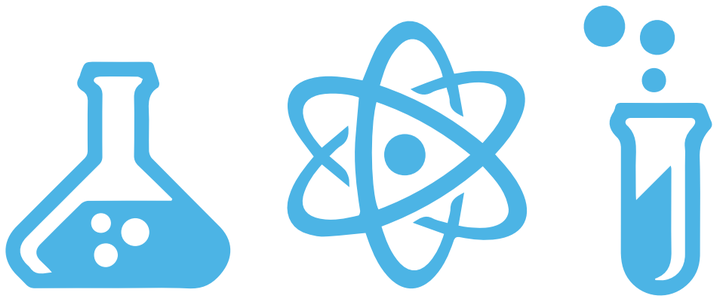
Repeat for the other side, and make sure you use a different color stick. Then switch roles and complete the experiment again.

DISCUSSION QUESTIONS

Why should the stick motion be detected long before the color is detected?

Why do we generally believe that we see color throughout visual field, and not just in a small focused area, if in fact we only see color in the central visual field?

COMPLETE YOUR LAB NOTEBOOK!



Name: _____

PROMISE SANFORD RESEARCH

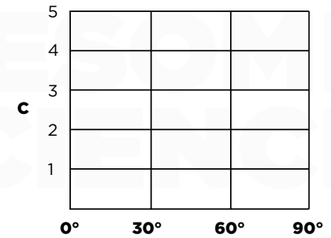
SEEING THE WHOLE PICTURE:
RODS & CONES

Answer the questions below as you progress through the Seeing the Whole Picture: Rods and Cones lesson and slideshow.

1. In the lesson slideshow, you will see 20 sets of colored circles. For each set, try to determine whether the left (L) or right (R) circle is overlapping the other. Circle your answer and mark ones you get wrong. After 5 sets, you will rotate your body and repeat. Record your answers in the table below.

2. Graph your results with C being the number of set you answered correcly.

	0°	30°	60°	90°
1	L R	L R	L R	L R
2	L R	L R	L R	L R
3	L R	L R	L R	L R
4	L R	L R	L R	L R
5	L R	L R	L R	L R
# Correct				



3. Fill in the KWL chart below considering thre following question.

How do you see color?

WHAT I KNOW	WHAT I WANT TO KNOW	WHAT I LEARNED