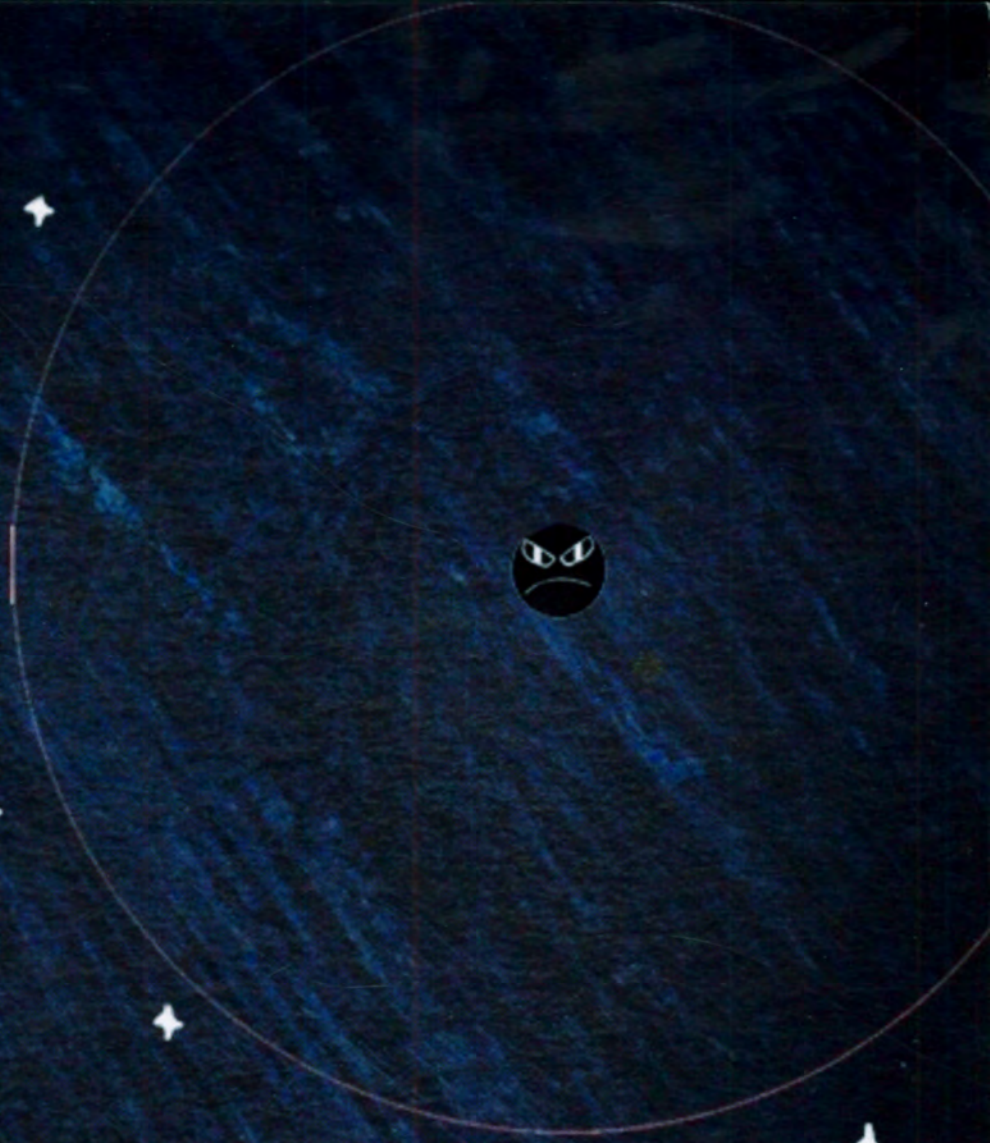


# Black Holes

What are they?




By: Ethan and Michael

This book was actually created for a school project at High Tech High. In this project, we researched an astronomy topic, wrote an essay on it, and converted our essay into a children's book. This was actually surprisingly difficult. We had to describe key terms that the average adult would understand, such as mass and density, at a kid's level. Overall, this was quite an interesting experience, in that we got to go through the process of revision and editing that is needed in groups if you are going to release a book.

We created this book on our chosen topic in order to further learn about space. Michael and I picked the topic of black holes. Before writing this book, we knew absolutely nothing about black holes. It was a complete mystery to us at first. However, through the course of this project, we learned basic information about black holes. We now know complex topics like how black holes are born, and what exactly they do. We just thought they were random spaces where there was no light. There's a lot more to it, though, and we hope you'll learn these things through reading this book.



One day in our solar system...




Hey, Sun!

Oh, hi  
Mercury!



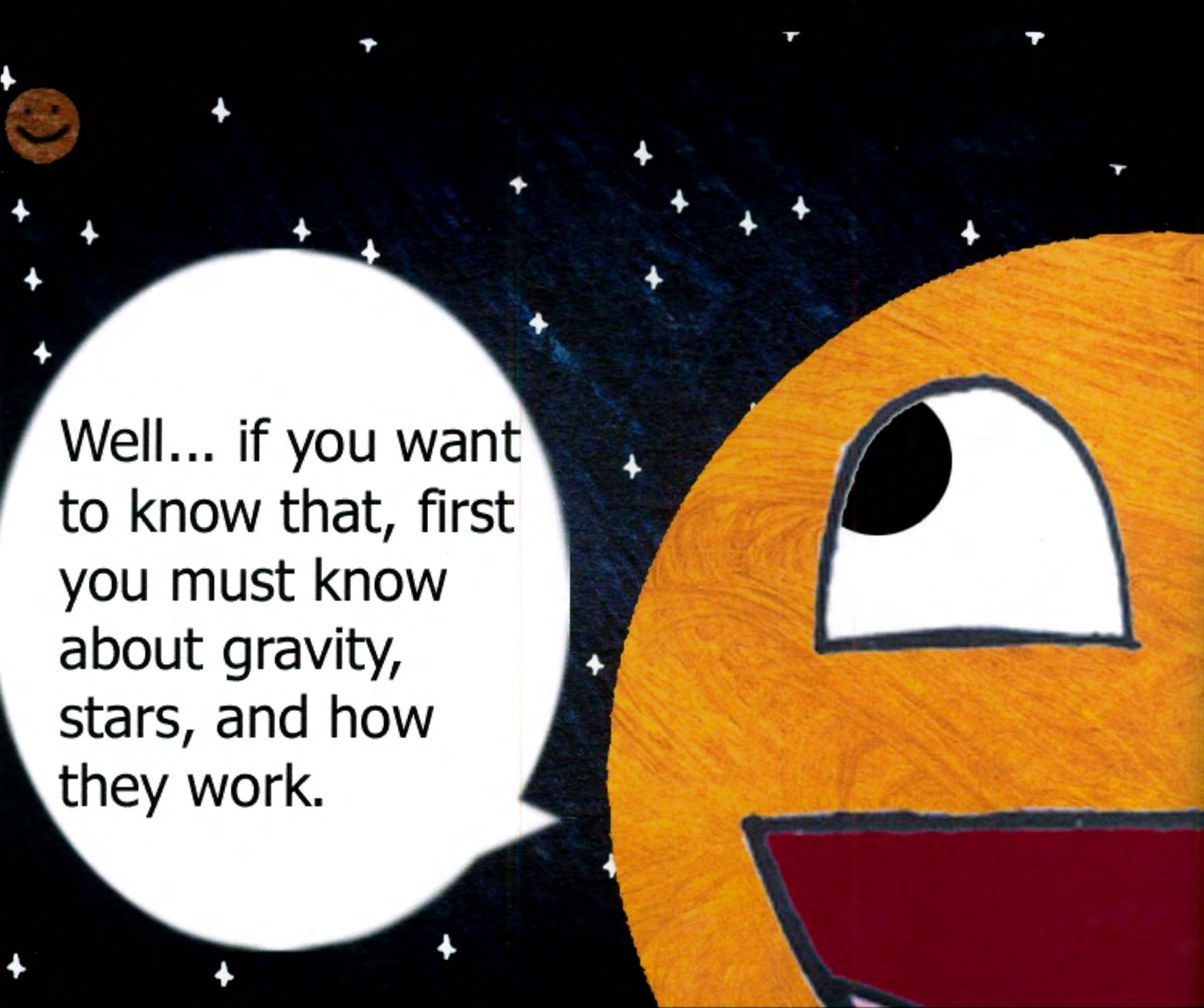




I was wondering, what's a black hole?

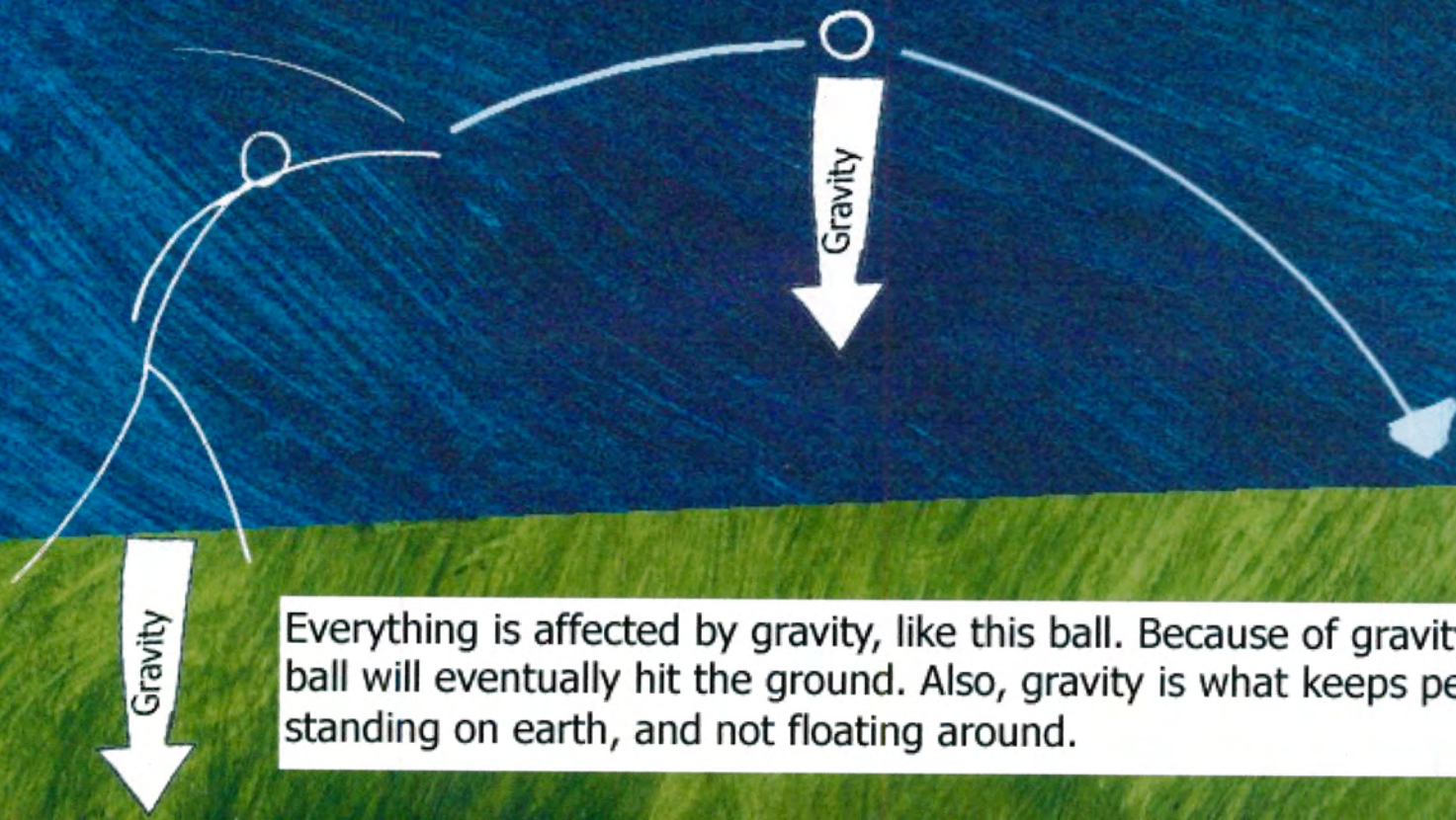




A whimsical illustration of a smiling sun with a face, set against a starry night sky. The sun is orange with a white eye and a red mouth. A speech bubble on the left contains text. The background is dark blue with white stars and a small brown planet with a smiley face in the top left corner.

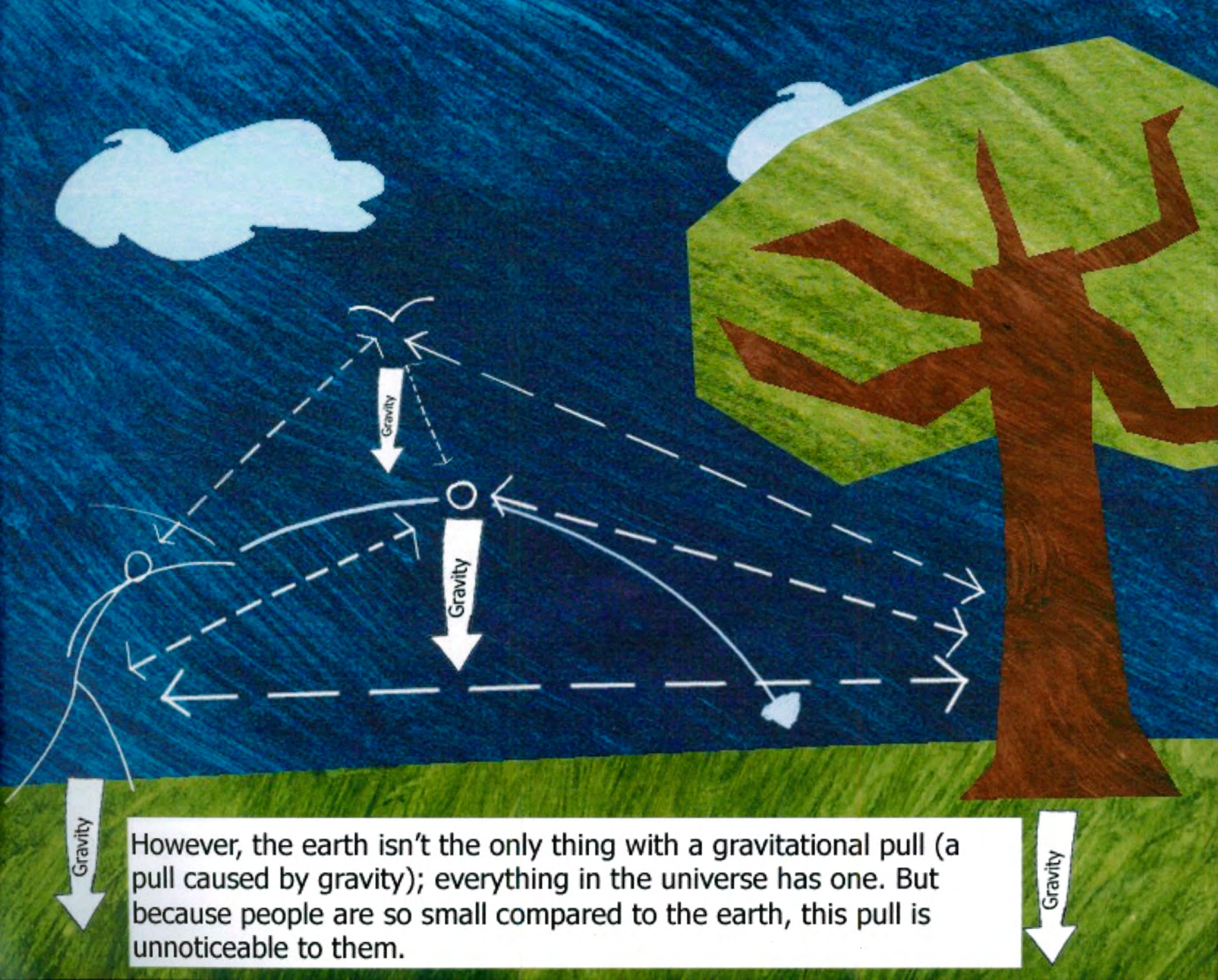
Well... if you want to know that, first you must know about gravity, stars, and how they work.





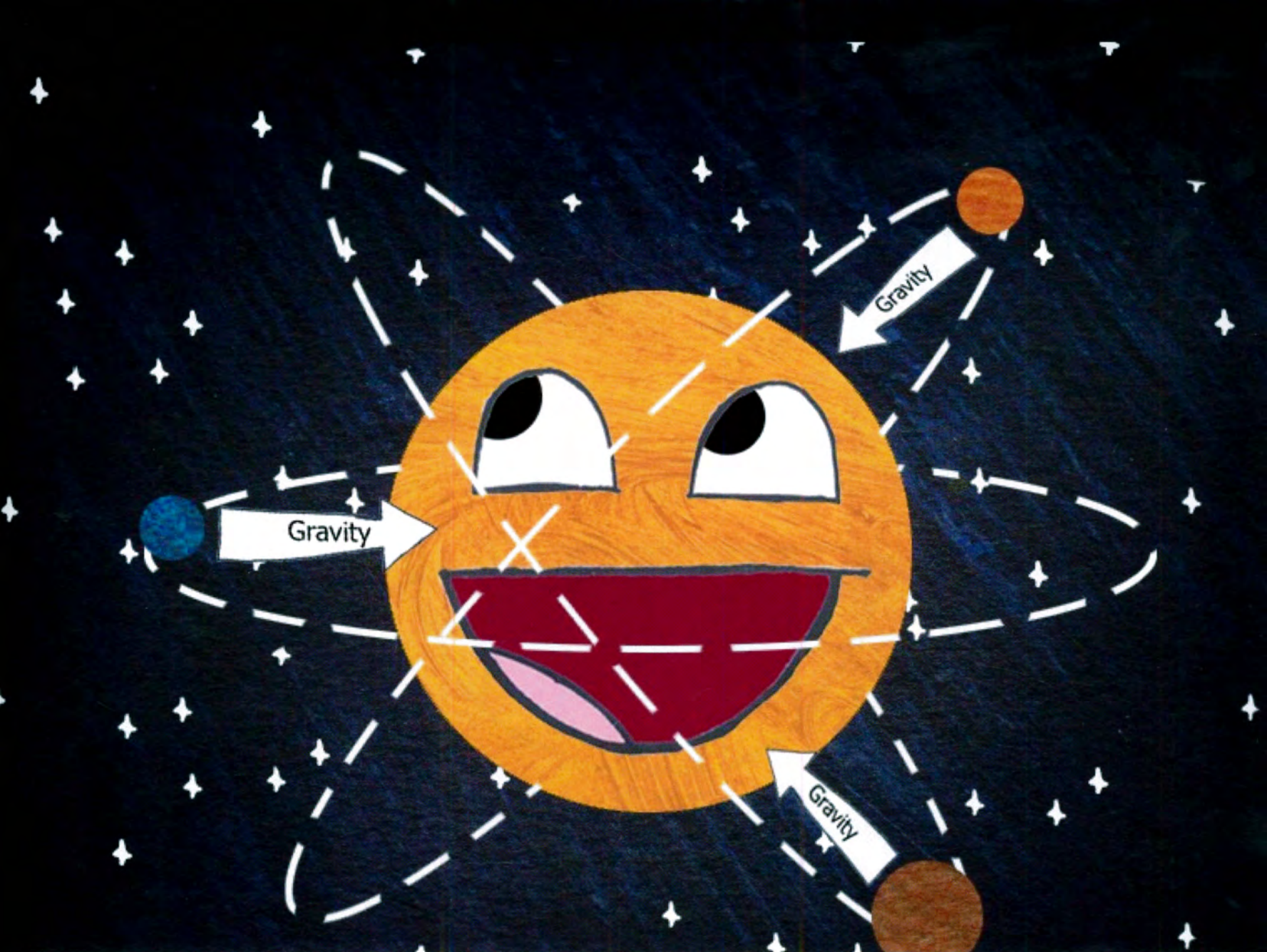
Everything is affected by gravity, like this ball. Because of gravity, the ball will eventually hit the ground. Also, gravity is what keeps people standing on earth, and not floating around.





However, the earth isn't the only thing with a gravitational pull (a pull caused by gravity); everything in the universe has one. But because people are so small compared to the earth, this pull is unnoticeable to them.





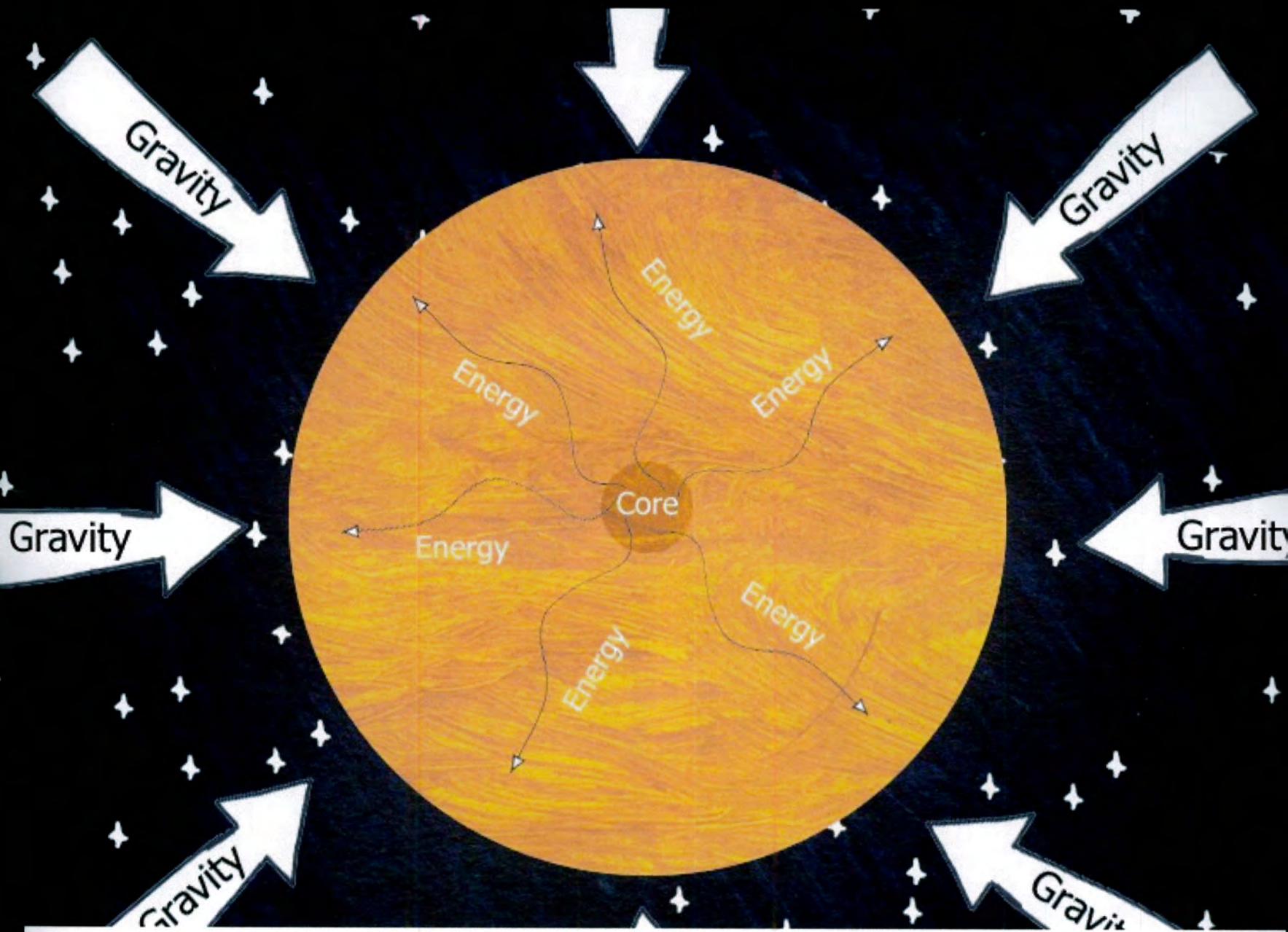
Even I, the sun, have a gravitational pull. This pull is what keeps planets and other things in orbit, rather than them shooting off into space.





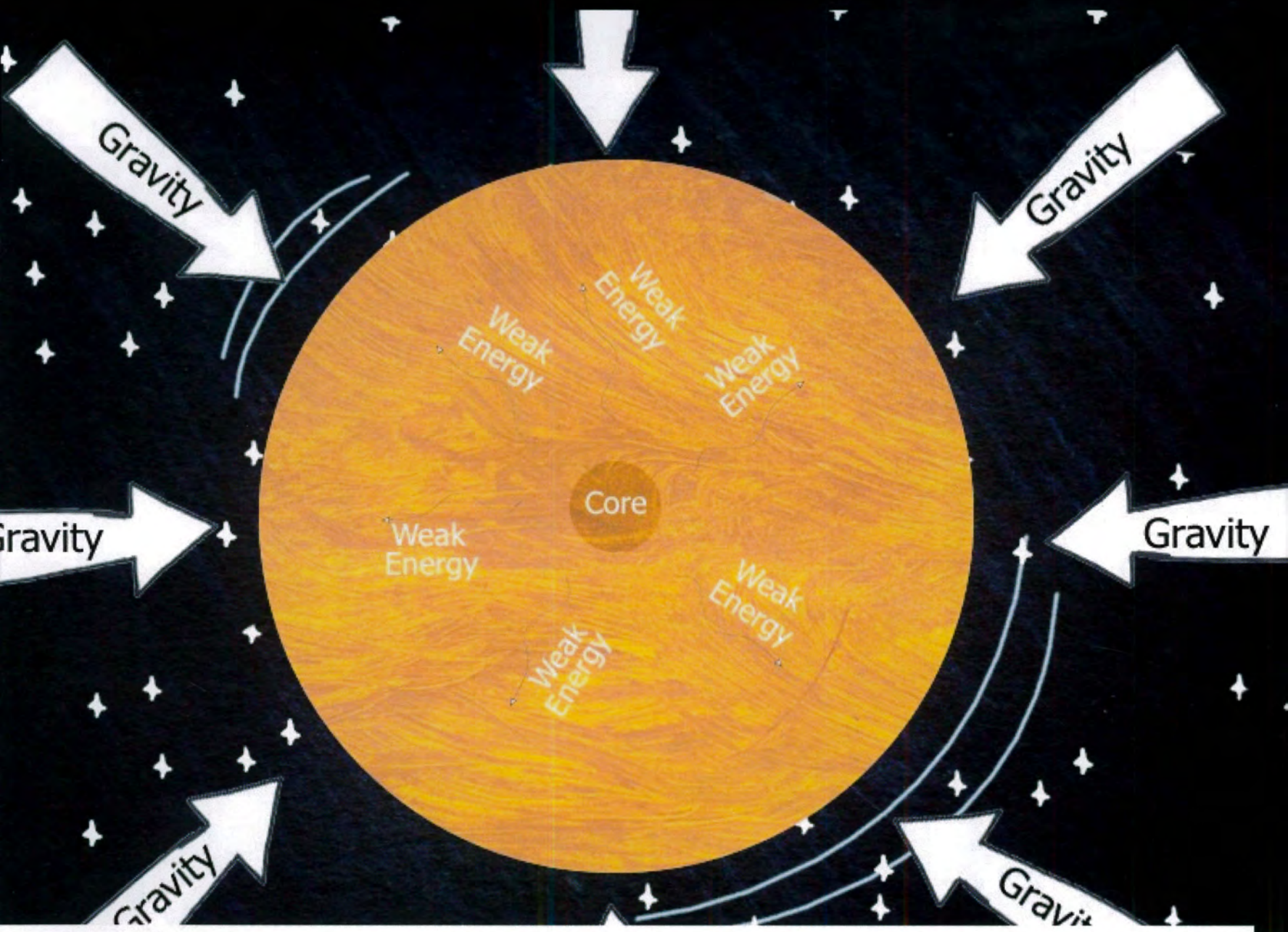
Gravity is actually what keeps stars together.





The energy inside of the star tries to push out, while the gravity pulls it together. This keeps the star in balance, so it doesn't explode or collapse.





Eventually, the star runs out of energy, and the gravity is stronger than the energy pushing out. This pushes the outer part of the star in.





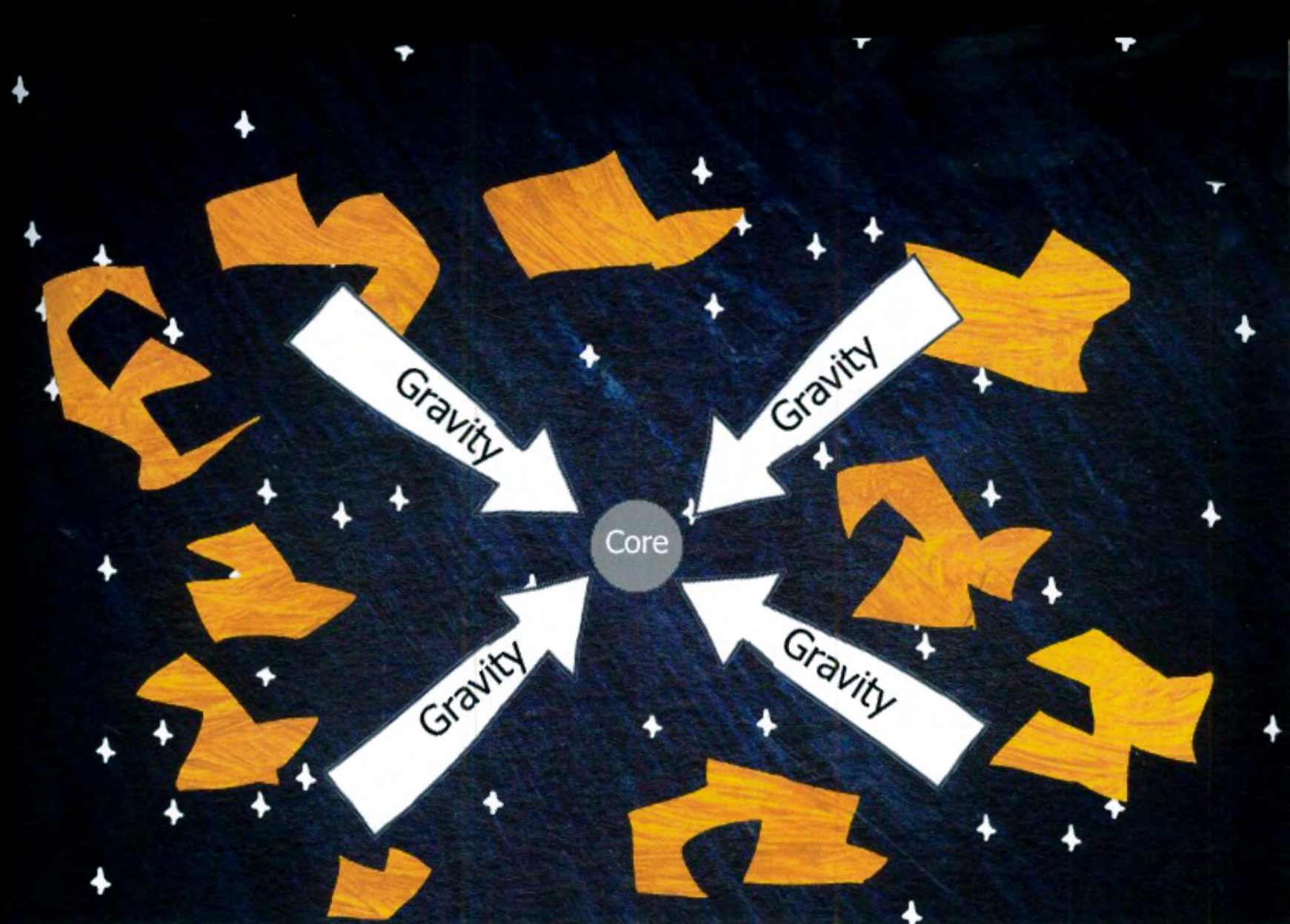
When the outer part reaches the core, it bounces off and explodes, causing a supernova.





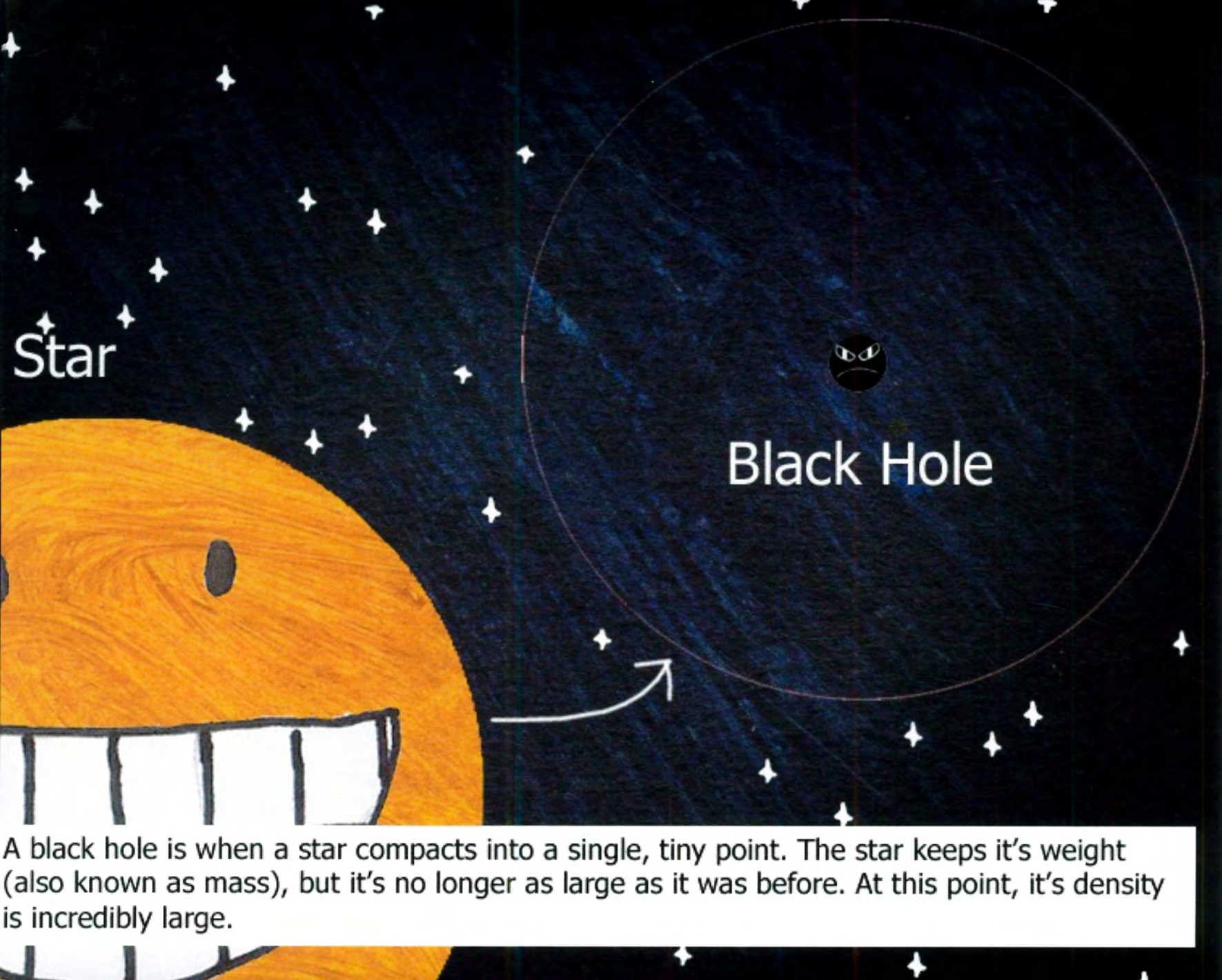
This leaves remnants of the star floating about in space.





Then, if the gravity is strong enough, it brings the remnants together, and crushes them into a black hole.






Star

Black Hole

A black hole is when a star compacts into a single, tiny point. The star keeps its weight (also known as mass), but it's no longer as large as it was before. At this point, its density is incredibly large.



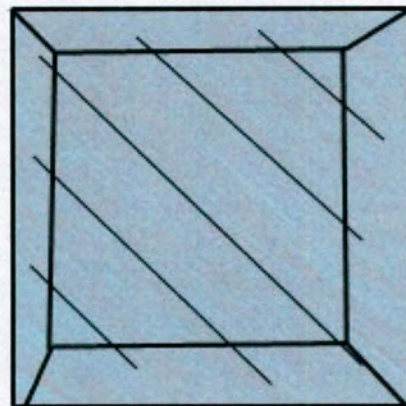


Wait, what's density?

10 Pounds

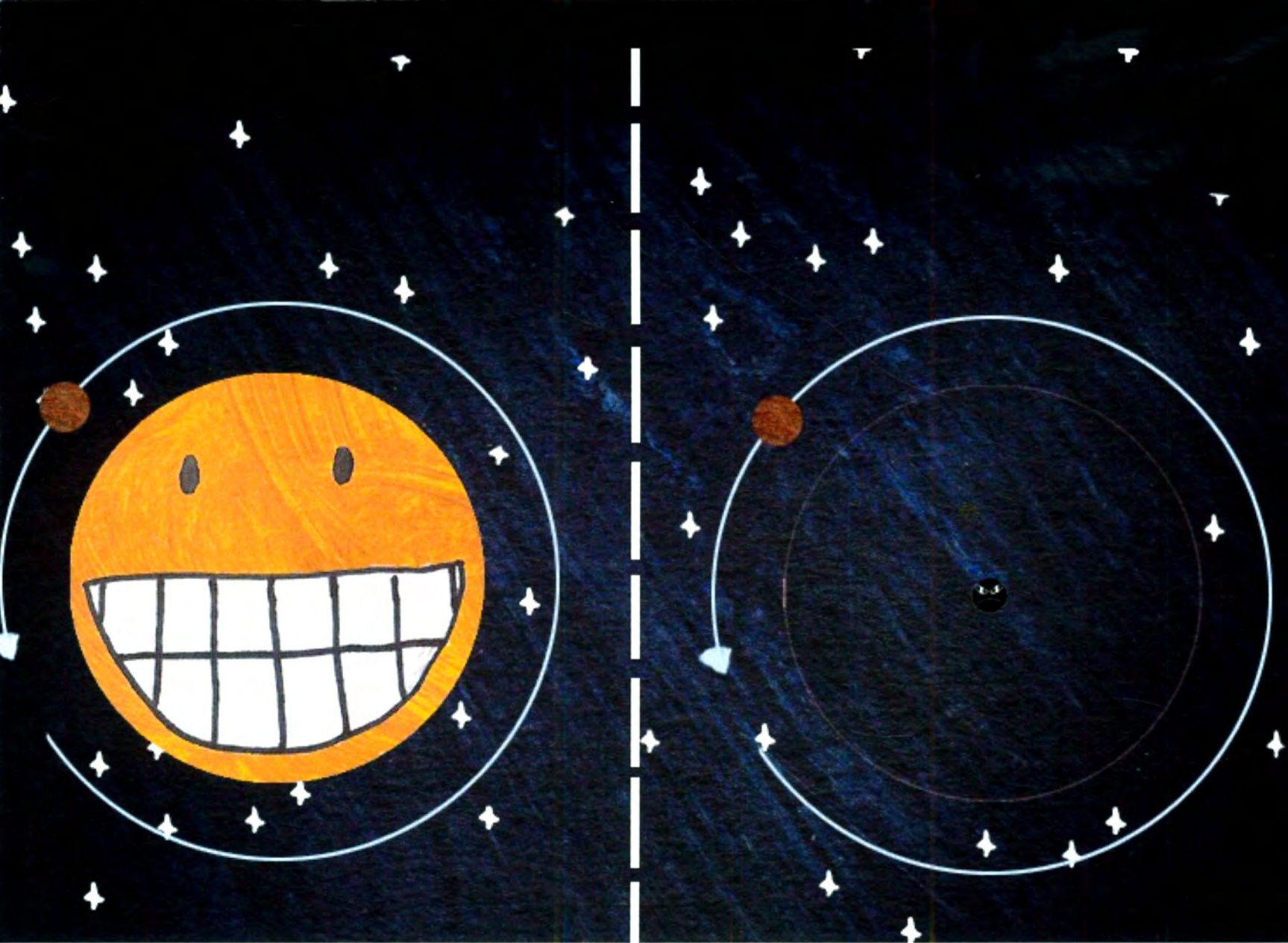


2 Pounds



Density means how much stuff (mass) is in a certain area. For example, let's say you have a cube made of bricks and a hollow cube made of glass, both the same size. The brick cube would weigh more because bricks are packed into the area, instead of the other cube which has only air in it.



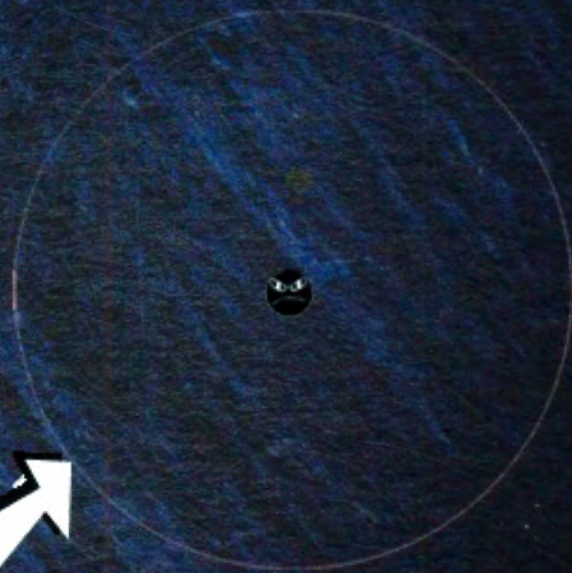


When a star becomes a black hole, the black hole's gravitational pull is the same as the star before it became a black hole.



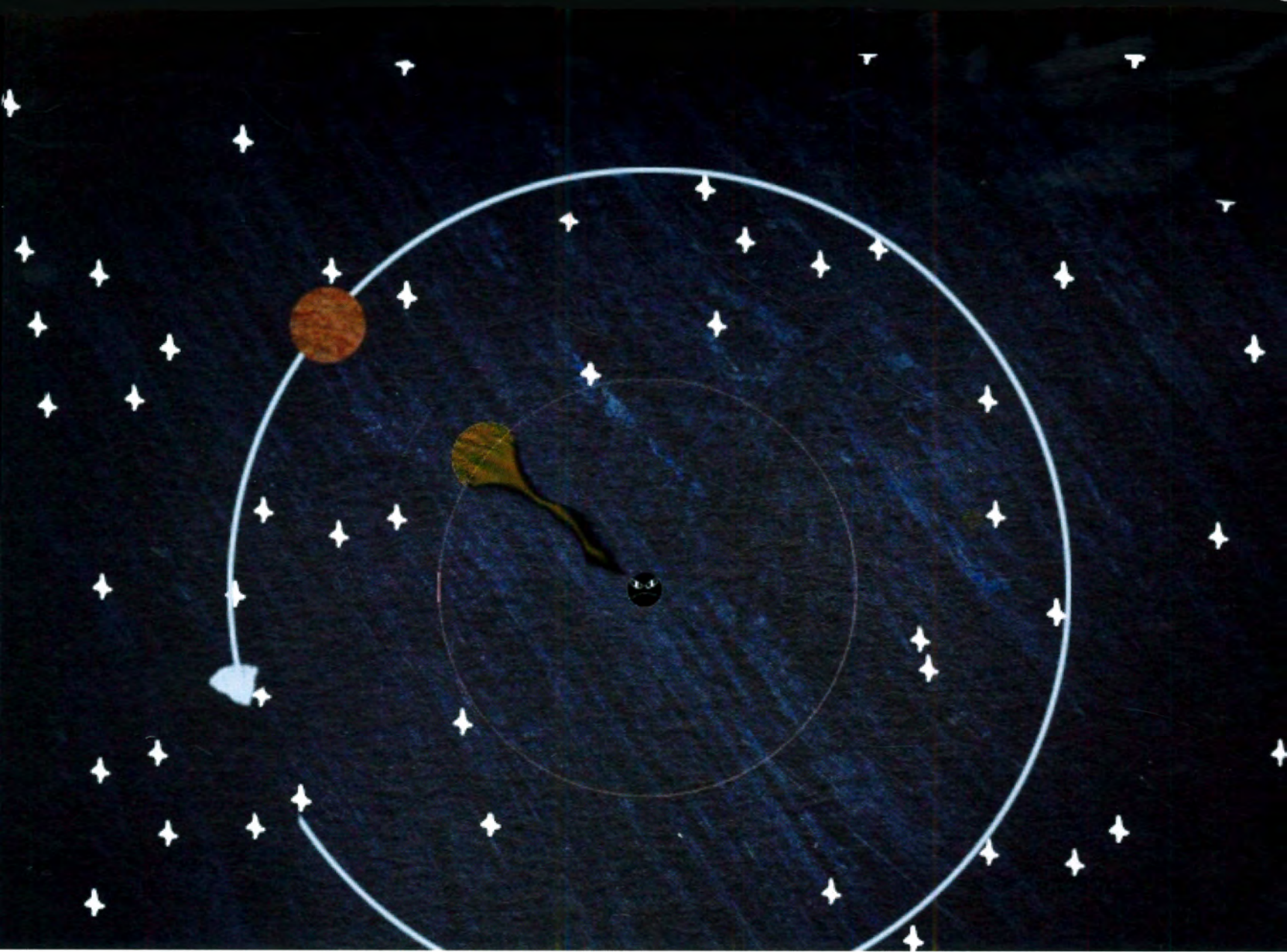


Schwarzschild  
Radius



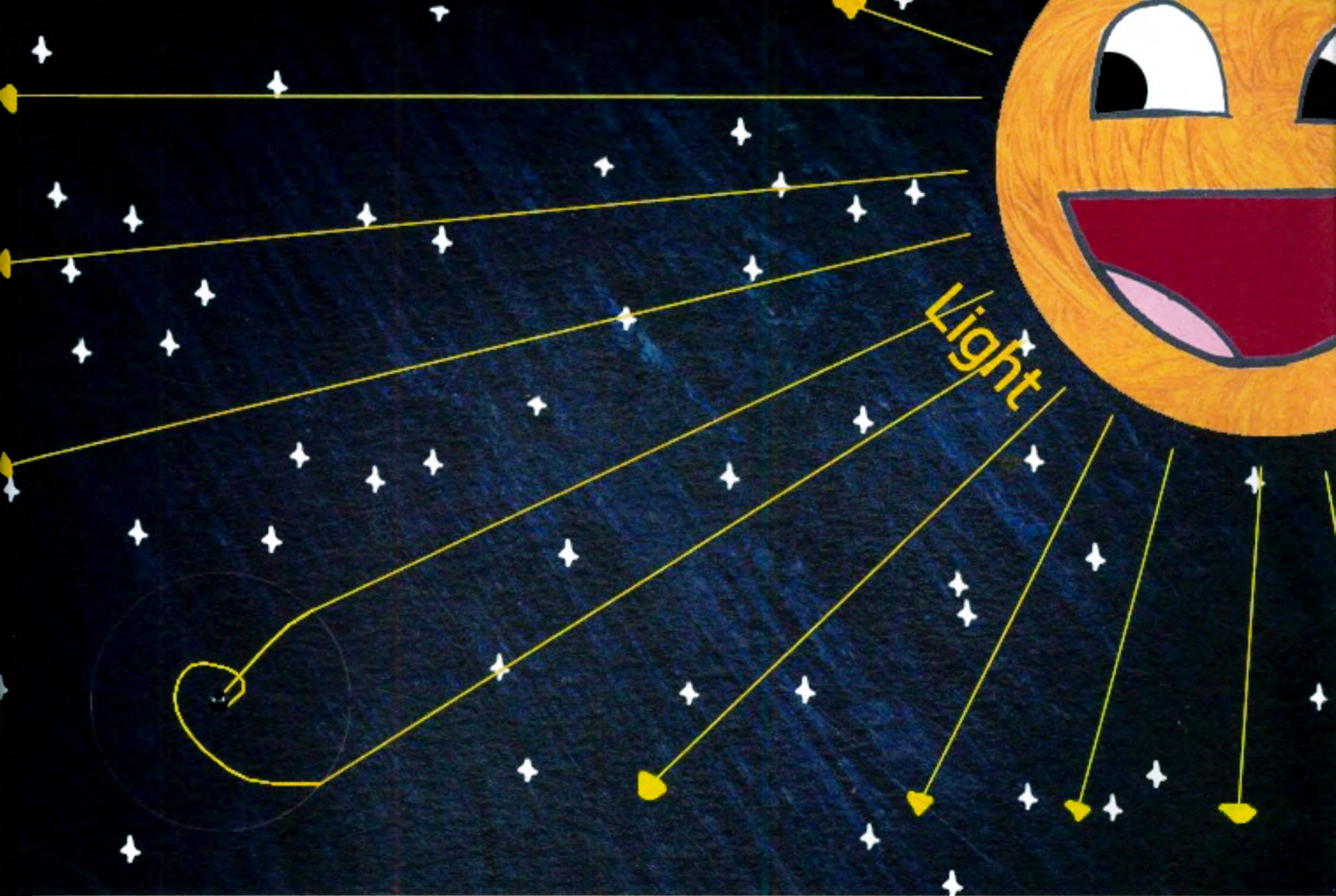
However, when a star becomes a black hole, not everything is the same. For example, the black hole has what is called a "Schwarzschild Radius".





The Schwarzschild Radius is a certain area around a black hole where, if crossed, it is impossible to escape its gravitational pull.






This means that even light, the fastest thing known to man, can't escape if it crosses.





Because of this, no one can see them! Not even with telescopes.

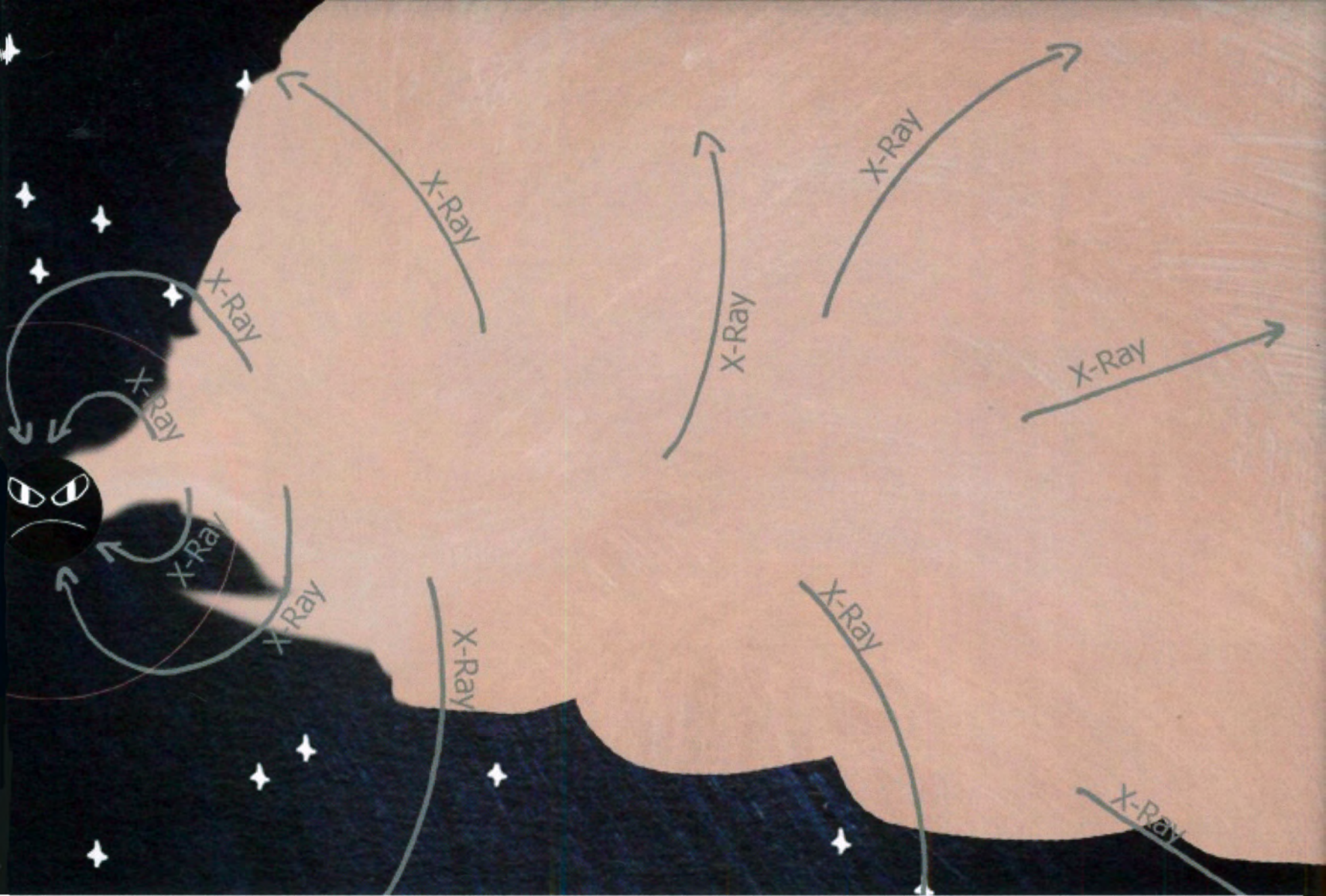




How do we know  
they're there, then?

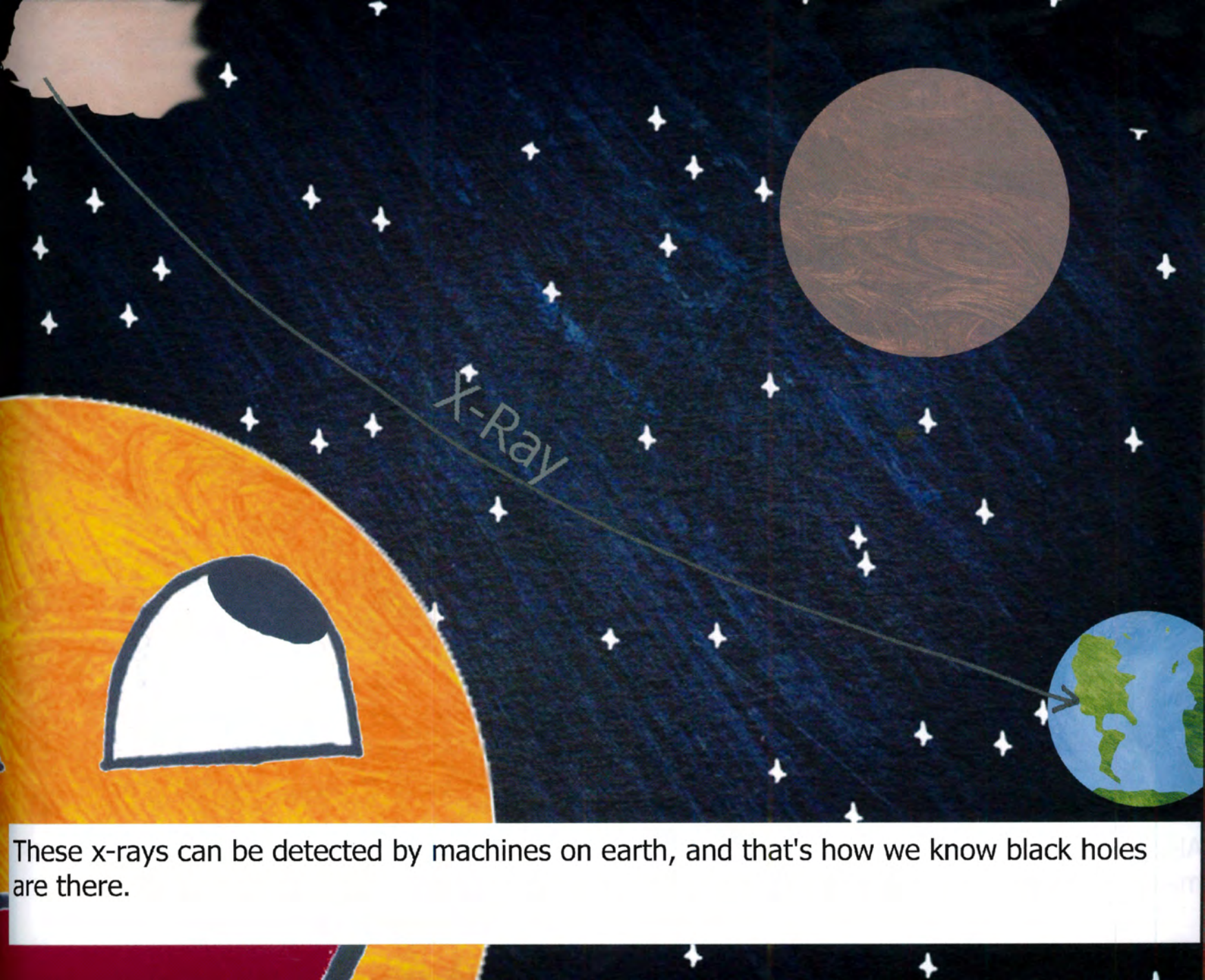
Well...





When space dust (bits of objects scattered in space) gets pulled in, the dust heats up and sends off x-rays. If these x-rays are sent off before crossing the Schwarzschild Radius, they escape!

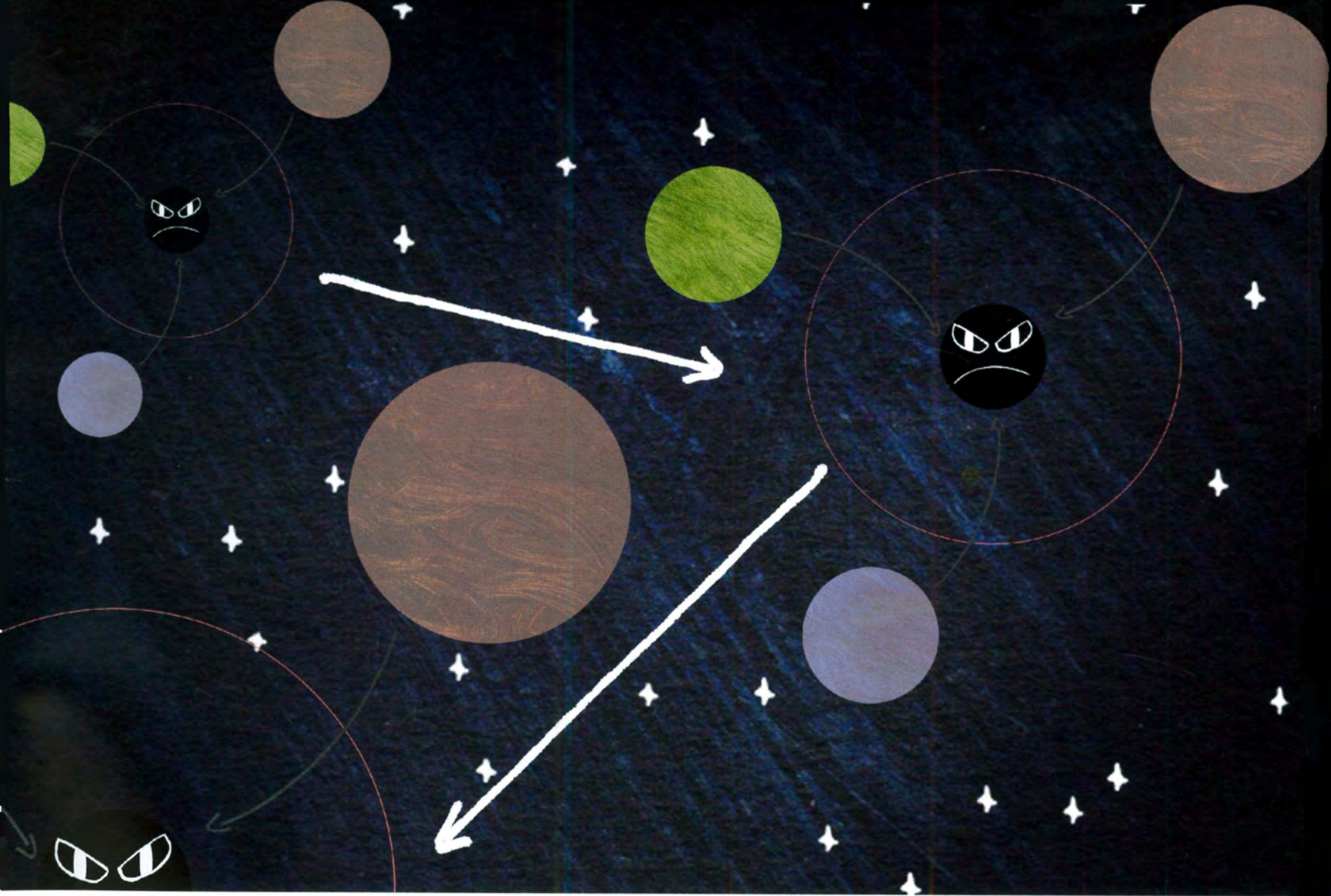




X-Ray

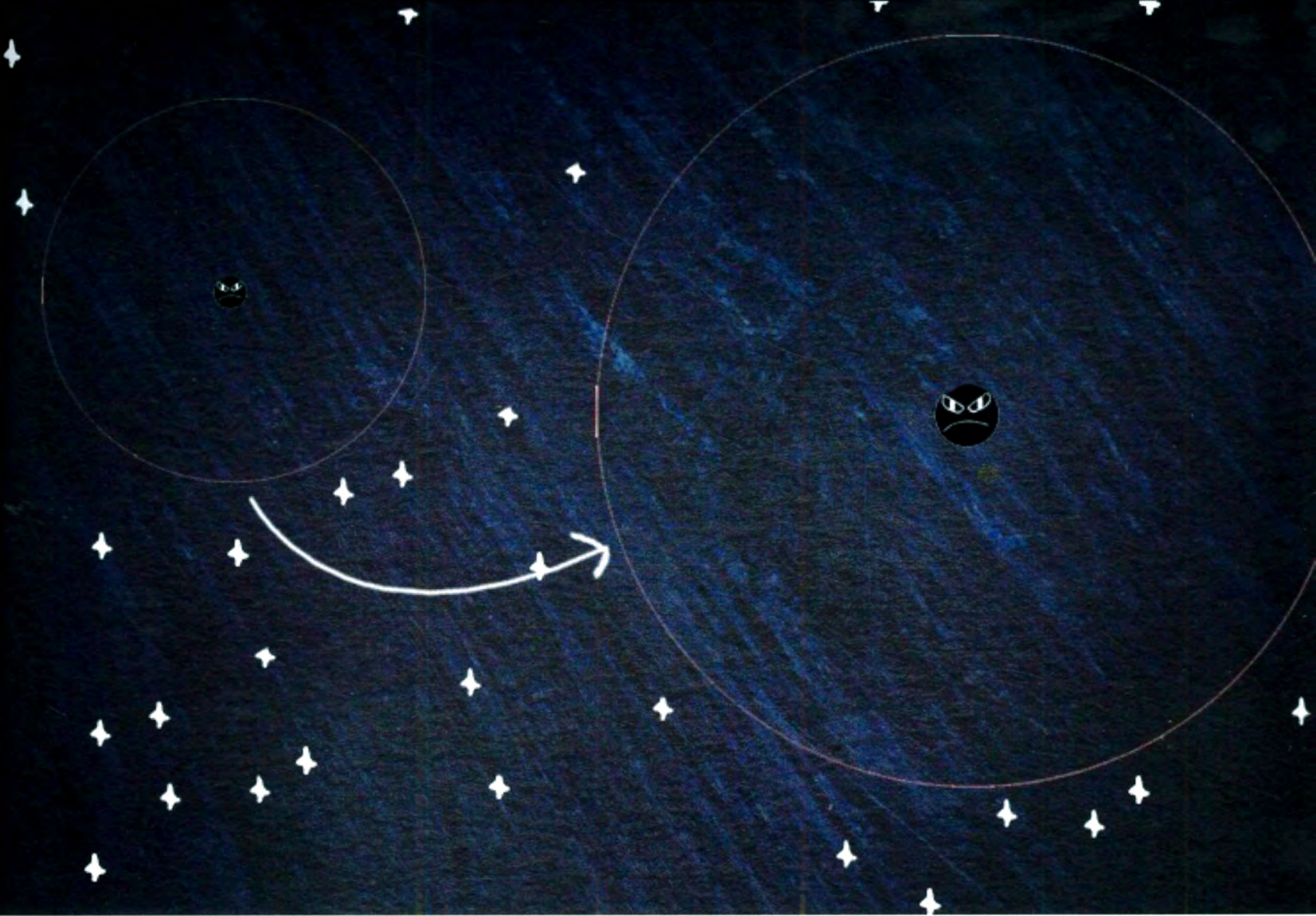
These x-rays can be detected by machines on earth, and that's how we know black holes are there.





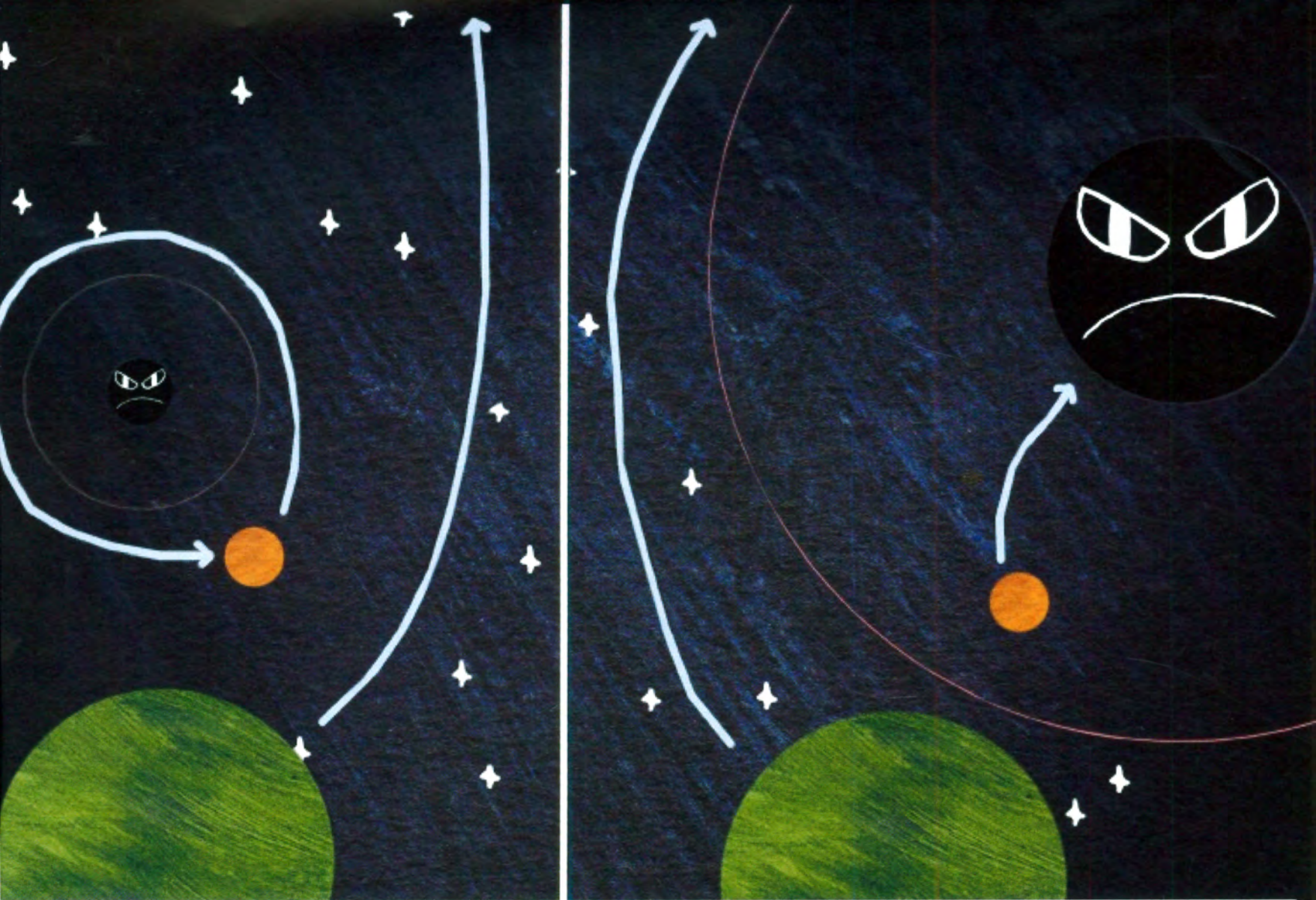
Also, when a black hole pulls in space dust or any other material, it slowly increases in mass. This is called accretion.





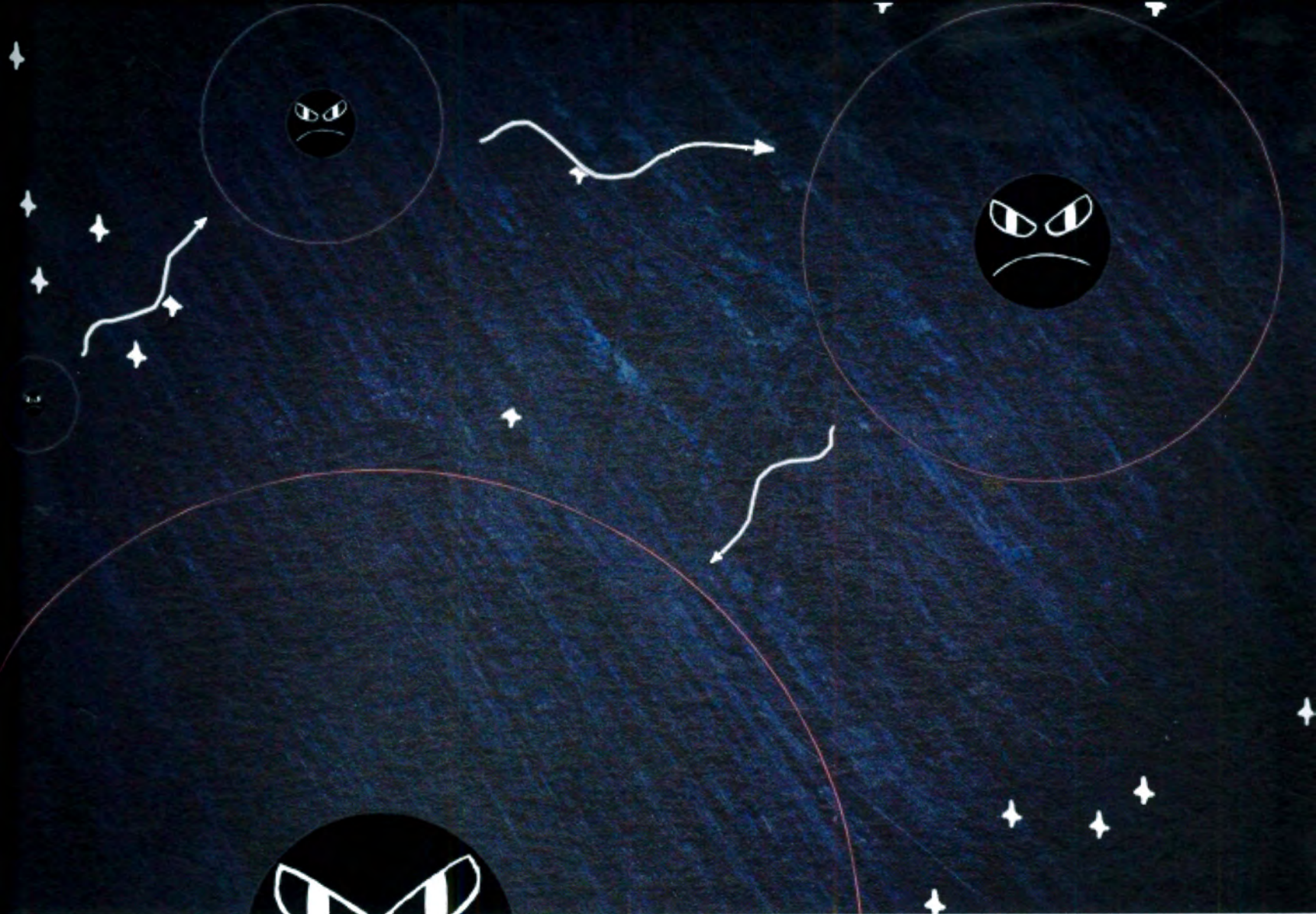
As a black hole gets more massive (has more mass), so does its Schwarzschild Radius.





If a black hole is more massive, and thus pulling stronger, it will have a different effect on the things around them.





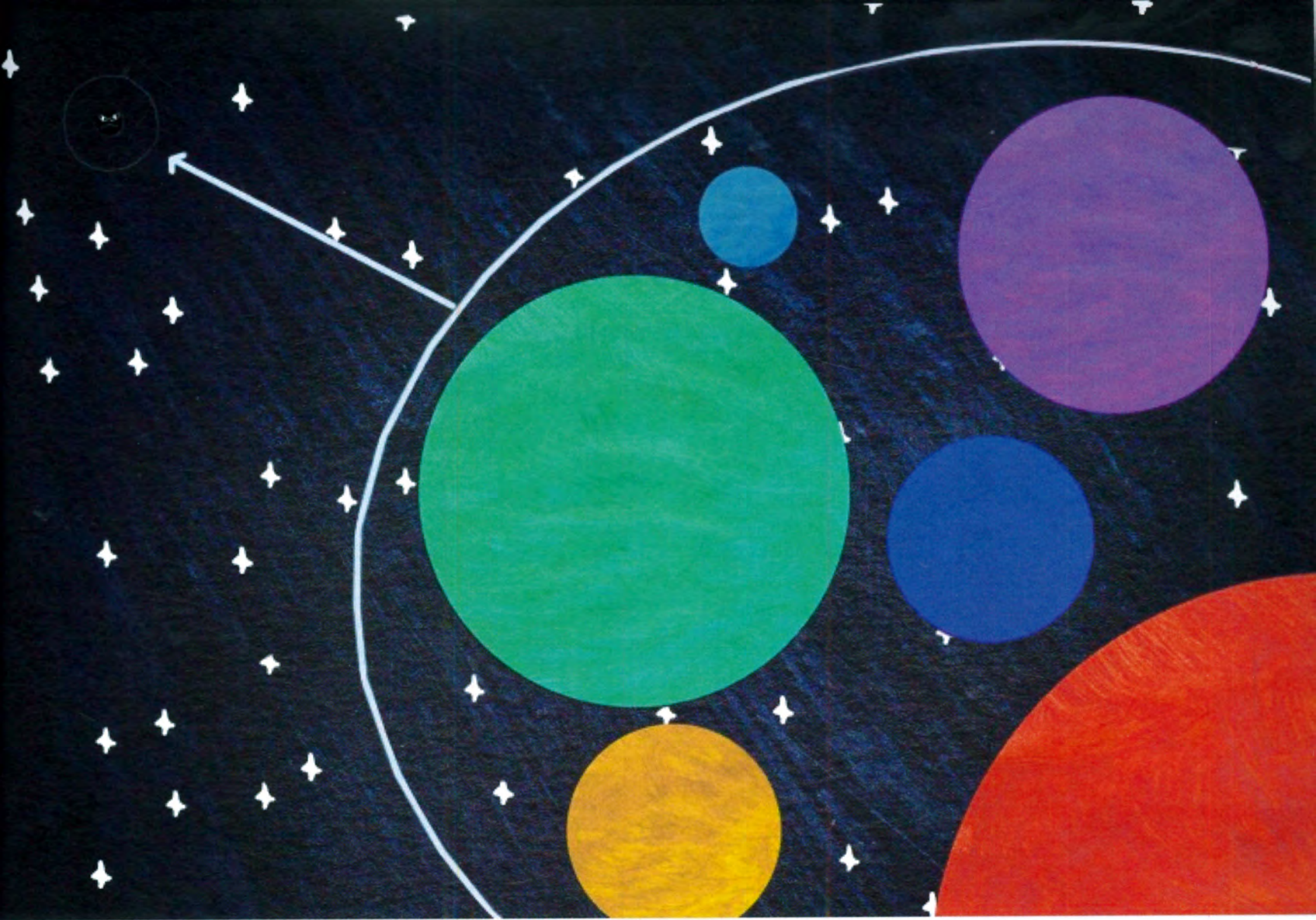
If a black hole gets massive enough, it becomes what is called a "supermassive black hole".





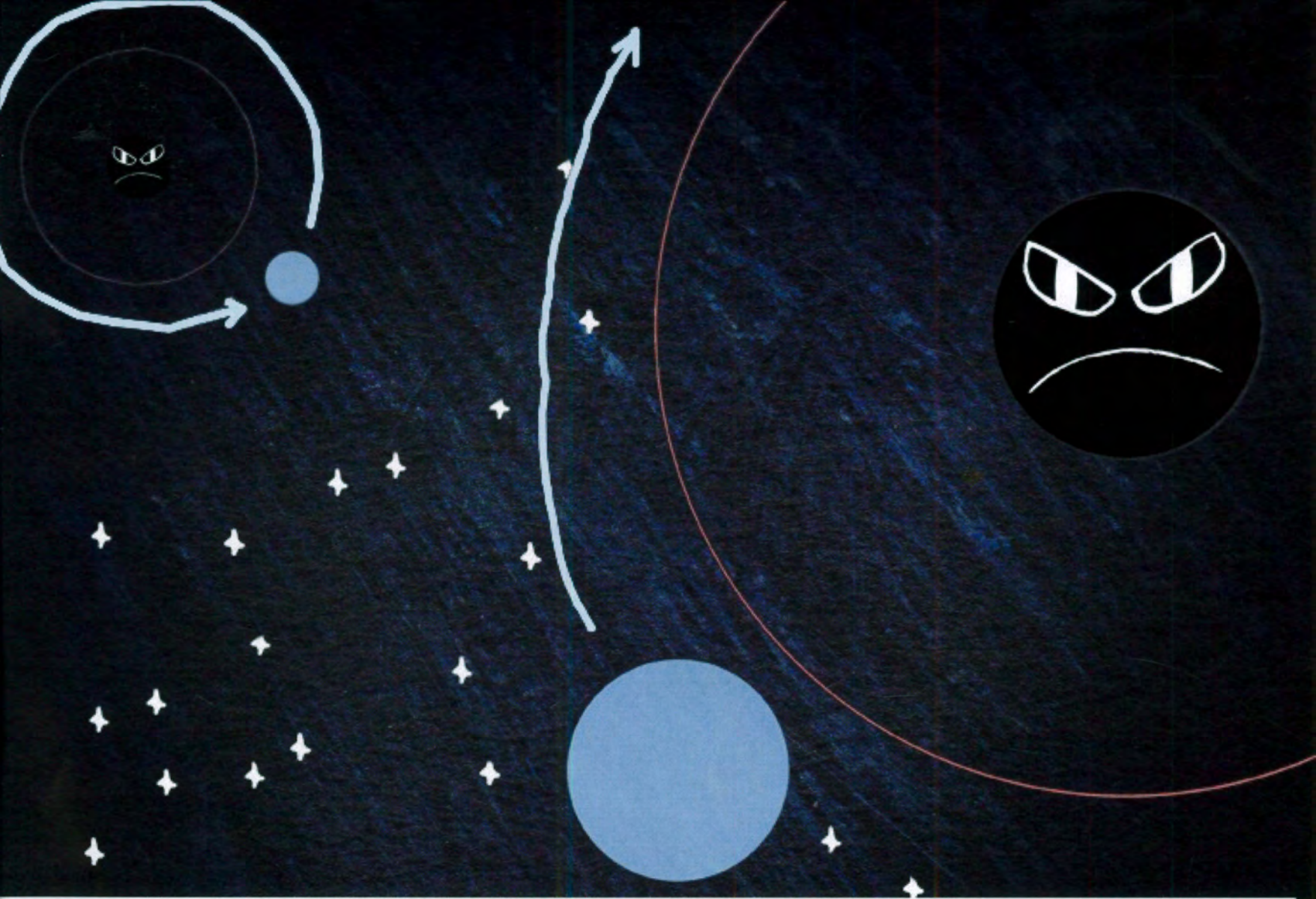
A supermassive black hole is many many times more massive than a regular black hole and many times stronger.





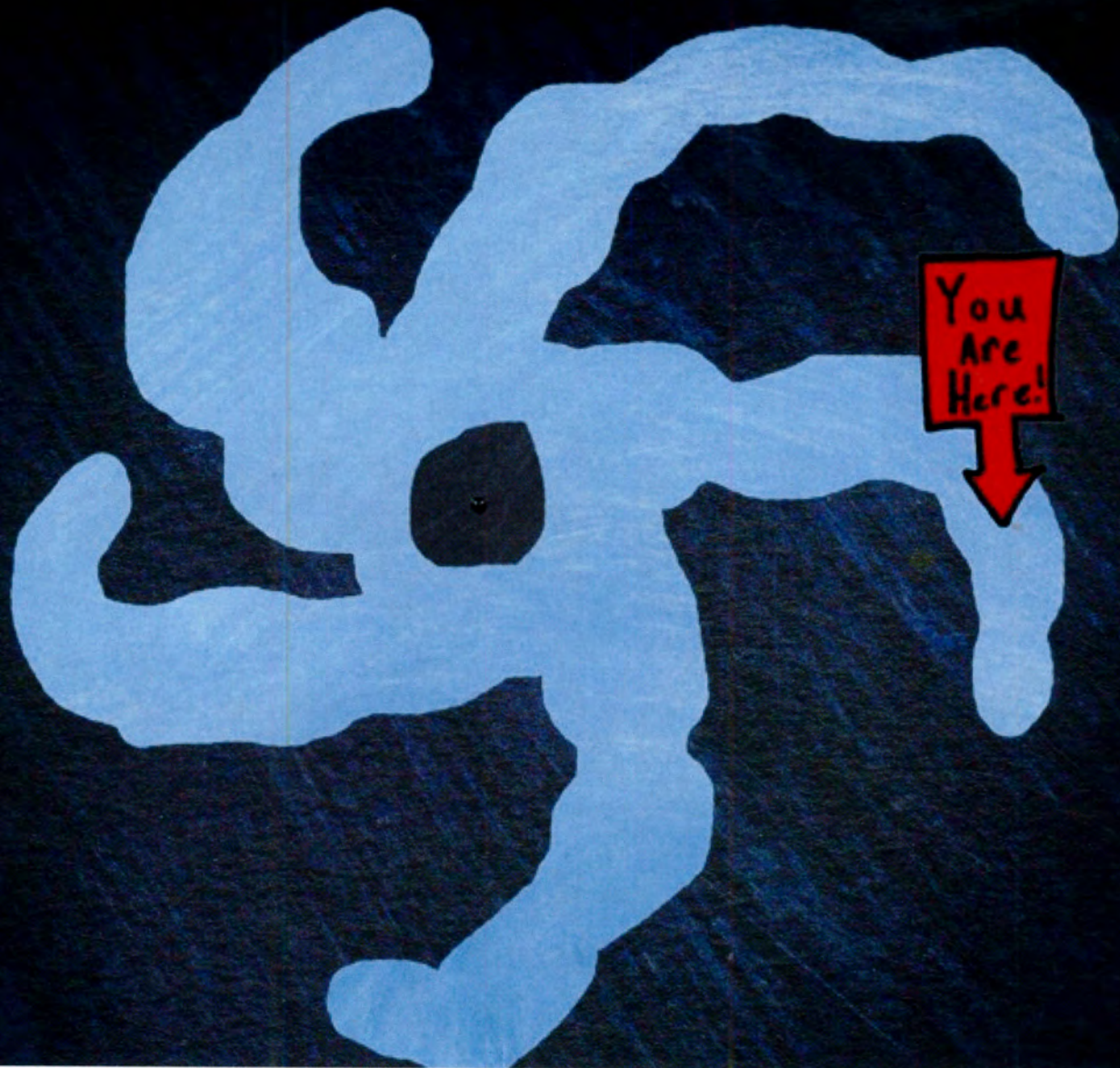
To become a supermassive black hole, a black hole must pull in billions of stars, planets, and other things.





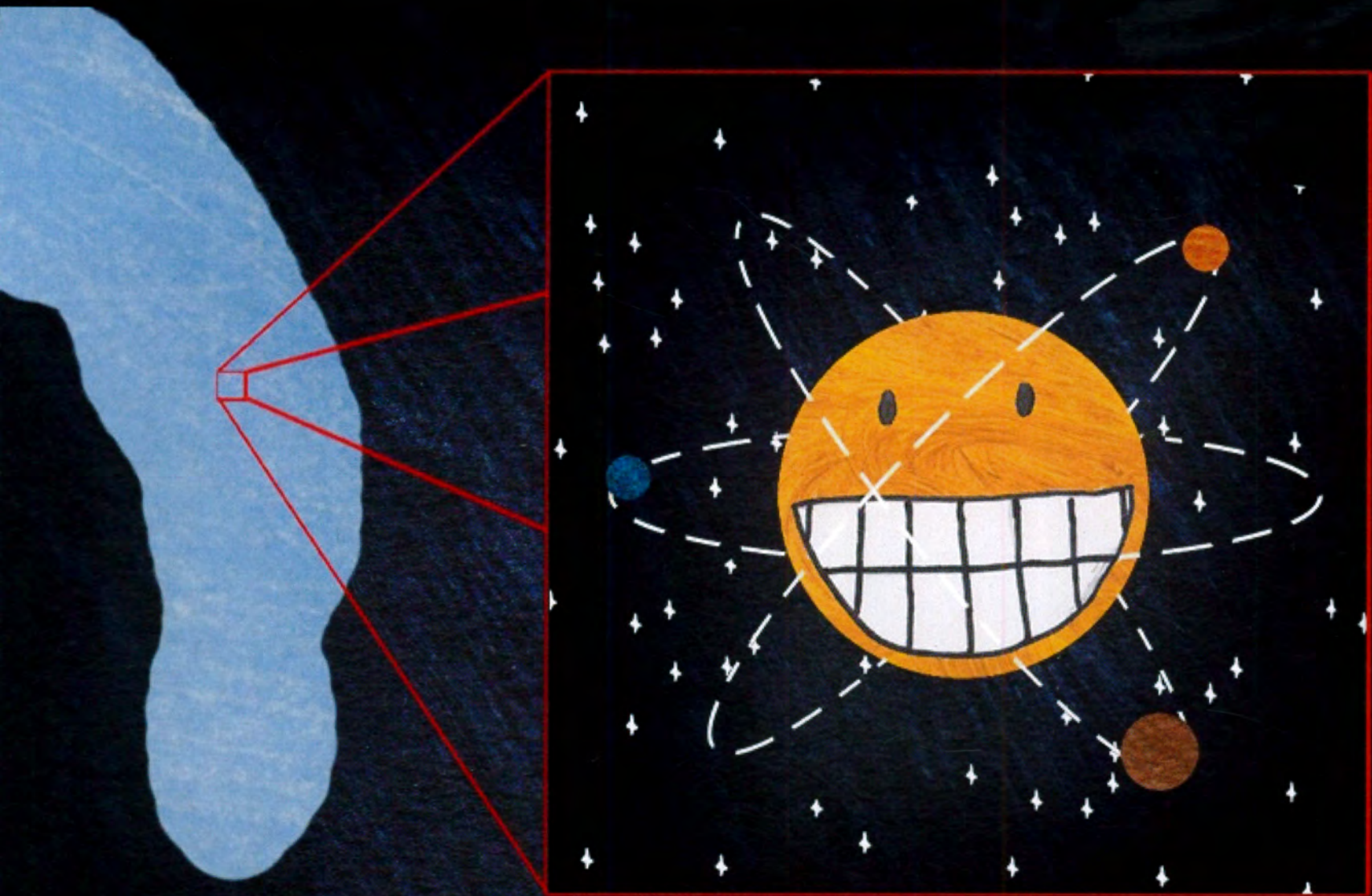
As we know, things like stars and planets orbit black holes. Since a supermassive black hole is WAY more massive, this means that larger, more massive things can orbit it.





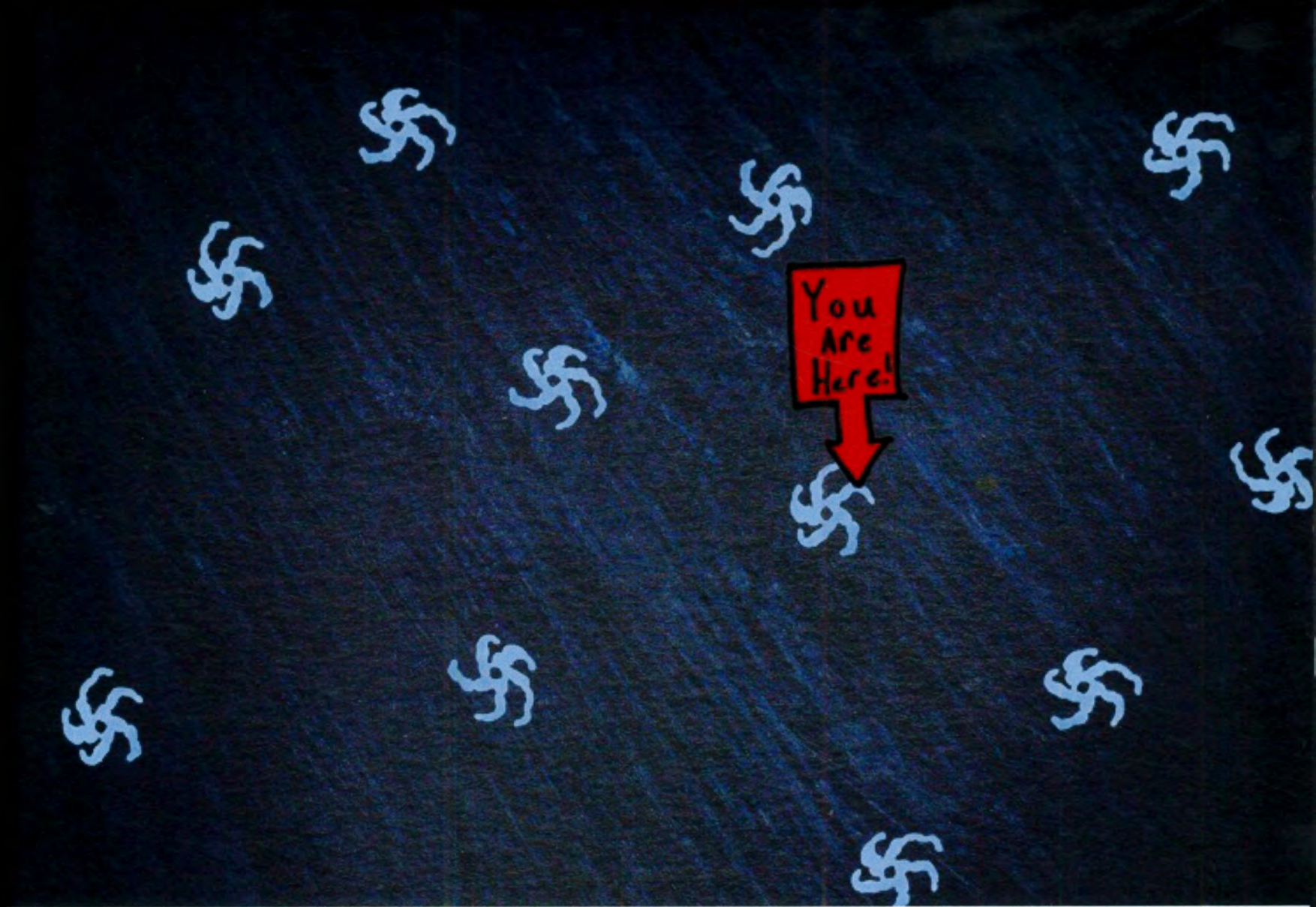
Supermassive black holes are so strong, that our galaxy may in fact be orbiting around one!





A galaxy is a grouping of millions of solar systems, stars, planets, and many other things. All of these things are orbiting one point.





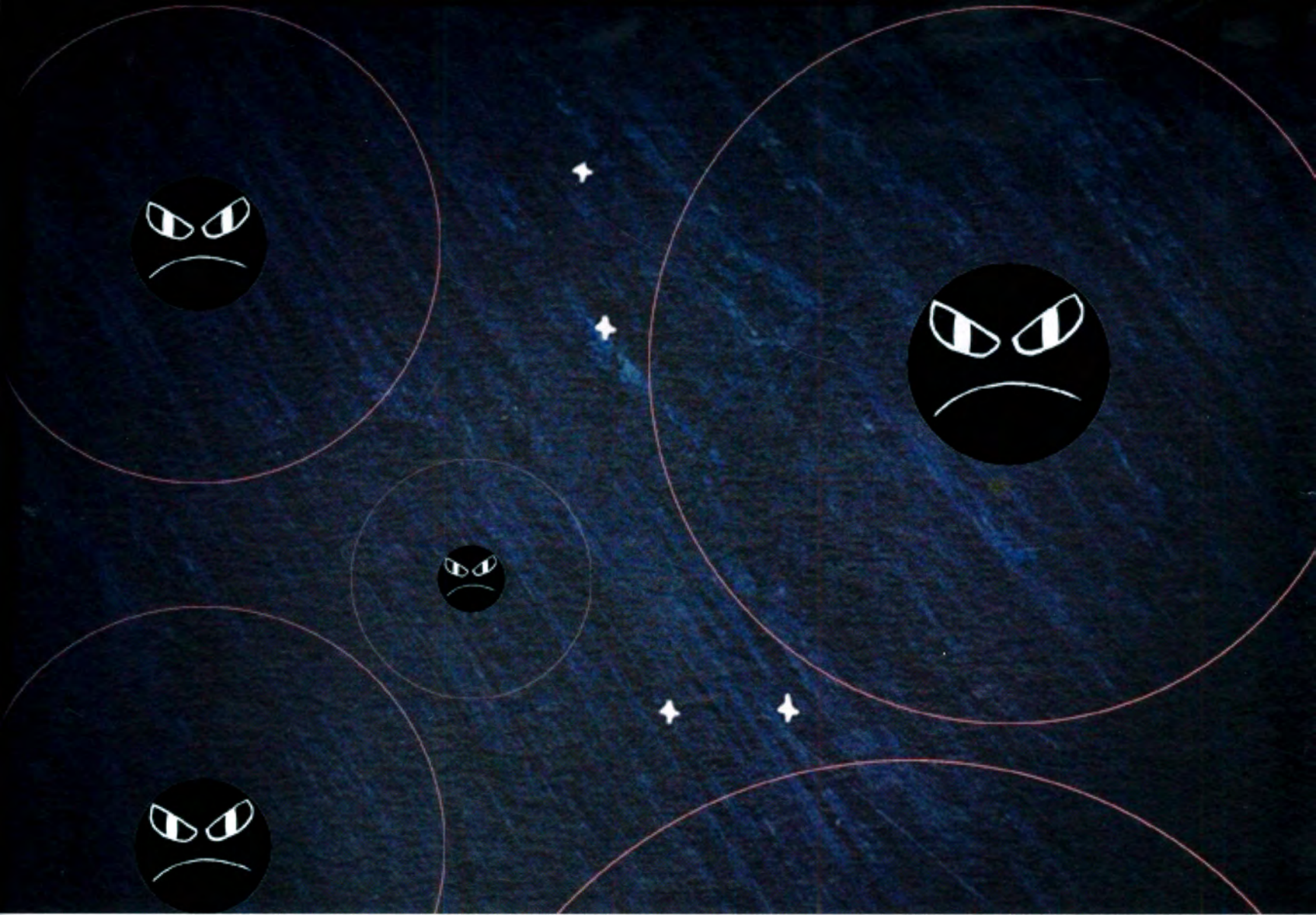
Some people also believe that most other galaxies also orbit supermassive black holes.





The whole universe contains a large, if not infinite amount of galaxies.






This means that if these people are right, there is a HUGE amount of supermassive black holes in the universe.





Cool! Does this mean you'll eventually turn into a black hole too?





No, not all stars can  
be black holes.

Really? Why not?




Well, first of all, to even  
have a chance of being a  
black hole, a star must be  
at least ten times bigger  
than me.



Oh.








It also depends on the mass, density, location, and a few other things.

I see.





So what happens if you don't become a black hole?

Well, that's another story!



# ~The End~

...I see...





