

# TUMBLE TRANSCRIPT:

## Episode 1 - The Scale of the Universe



ME: When you look up at the sky at night, what do you see? Maybe you've gotten good at finding a few constellations, or you can track the phases of the moon. But did you know that, by looking at the sky in *just* the right way, you can answer some of the biggest questions that have ever faced humanity? Questions like: how far away *are* those stars? And what are they made of? And just how big *is* the universe, anyway?

### [INTRO MUSIC STARTS]

ME: Hello, and welcome to Cataloging the Universe! I'm Marshall, and I'll be your guide on this journey. In this 6 part series, we'll be taking a journey through time and space to try to find our *own* answers to these giant questions about the universe. You will learn some history, start your own star journal, and even get to help scientists today identify distant galaxies. Along the way, we'll have some help from astronomers and our imagination.

Let's get started! This is Lesson 1: The Scale of the Universe.

### [INTRO MUSIC ENDS]

ME: People have been looking to the night sky for answers for thousands of years. And every so often they find something that changes everything. After decades of believing the universe only contained a single, small galaxy, with our sun at the center of it - about a hundred years ago, all of that began to change.

New measurements for stars challenged how big we thought the universe was and where we sat in it. Let's go back in time to learn more.

### [TIME TRAVEL MUSIC]

ME: It is a cold day in April in Washington D.C. in the year 1920, a crowd gathered to hear two different takes on the hottest topic in astronomy: how big is our galaxy, and what - if anything - is beyond it? Two astronomers, Harlow Shapley and Heber Curtis, are setting out to prove each other wrong, in what became known as The Great Debate.

Look over there. That's Harlow Shapley, he's a young hotshot astronomer. He will be presenting first at the debate. I see he's got lots of people gathered around him.

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[Sounds of Shapley talking to other astronomers]

ME: Shapley was 35 years old, very early in his career, when he made some discoveries that got everyone in the astronomy world talking. He believes he can prove that our Sun is NOT the center of the universe, and even more he hypothesizes that the universe is at least ten times larger than *anyone* ever thought. That's why he was invited to this very important public debate.

ME: Let's see if he will talk to us quickly about his research.

ME: Hi Dr. Shapley, excuse me, sir. Excuse me, could I have a moment of your time before you start your speech?

**HS: Hi. Um... yes. Sure. But quickly, I need to go get ready.**

ME: Great. Thank you. Well, Dr. Shapley. I'm trying to teach our listeners about how extremely big the universe is and how scientists know that. I was hoping you could help?

**HS: Well, it's strange how little we know about this universe. Really strange when you think about it, but I believe we know more every day. And today I will be presenting data proving that space is bigger than anyone thought possible.**

ME: What are your findings?

**HS: Astronomers mostly agree on the distances of nearby stars, but there is a lack of agreement on the distances of groups of stars and star clouds. Finding those distances changes the scale of all known space. These distances can change everything.**

ME: Wow. You said there is a disagreement?

**HS: Yes. Dr. Curtis** thinks that I'm wrong about the size of the star system. But I obviously don't agree! Not only do I think his idea for the size of the galaxy is far too small, but I think he's wrong that our solar system is near the *center* of it.

ME: Wow.

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**HS:** Copernicus put the Sun at the center, I put it somewhere else... I say 'I tucked it away, rather carefully.'

**ME:** And what does Heber Curtis about moving the sun to a different place in the universe?

**HS:** Well we are here to debate. We agree on some things, but not these. You will have to talk to him to get his side of things.

**ME:** I will do that! Thank you for your time Dr. Shapley.

**ME:** So interesting. He is really challenging some long-standing ideas. Of course, with every new idea of what the universe might look like, there's always someone who doesn't agree. Today, that person is Heber Curtis, he's here to counter Shapley's grand vision of the universe with one of his own.

**HC:** Hello. Yes, you. I see you were talking to Shapley. What is he telling you about the universe?! Let me guess, it is infinitely more big than we can imagine? That the sun isn't in the center? Hmmf.

**ME:** Oh, hi Dr. Curtis. Just the person I was looking for. Yes, he was talking about his view, but I was hoping you could comment about the size of the universe as well.

**HC:** Happy to.

**ME:** Great, thank you.

**HC:** First off, I'm confident that Shapley's measurements are wrong.

**ME:** So you don't think it is as huge as he says?

**HC:** The Milky Way can't possibly be as big as he thinks. And his idea of the sun being at the edge of the galaxy, and not in the center, my data just doesn't support this.

**ME:** You believe that the universe is smaller?

**HC:** I don't believe the universe is small at all! I just don't think our galaxy is as big as he says. Shapley calculated the Milky Way is 300,000 light-years across, I

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believe it is closer to 30,000 light-years. Which is still very large, and I agree there are star systems infinite distances from our own.

ME: If you agree there are stars infinite distances from our own, why do you think our galaxy is so much smaller than Shapley's estimates?

HC: I believe our star system, or galaxy, is more limited. It isn't the whole universe or all of space. We are one part of many parts out there. I think there are "island universes" outside of what we know. Entirely different galaxies, separate from our own.

ME: Different galaxies? That is also a very big claim. What will you present today to support that?

HC: I study objects in the sky called *spiral nebulae*. I believe they are full of stars beyond our star system.

ME: Spiral nebulae?

HC: "Nebula" is a word in Latin that means "cloud." A spiral nebula is pretty much exactly what it sounds like: a cloud in the shape of a spiral. That is what we see when we look at them in the sky. Nobody knows what they are exactly, our telescopes can't quite see what they are made of yet.

ME: If you can't see what they are made of, what do you use to study them?

HC: I study the light or spectrum from the spirals. This light is what you could expect from a galaxy of stars. Not just space dust like Shapley believes.

ME: And this is why you call the spiral nebulae island universes?

HC: Precisely, I believe they are "island universes:" other star systems, filled with planets and stars much like our own.

ME: That's a pretty great way to talk about it - an island universe. But what do you think about Shapley's position of the sun?

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**HC:** Yes, well that is another thing I don't agree with Shapley on. He says our solar system isn't in the center of the galaxy, but I disagree. Science has proved that for a long time, *our* solar system is in the center.

**ME:** I mean science changes our understanding of things. Don't you think it could be possible?

**HC:** **Maybe, but that is a big shift. It would change a lot. I don't know if his numbers support it.**

**ME:** So you both have some new ideas and hold onto some old ones. What would you say is the purpose of this debate?

**HC:** **Defining our galaxy and the universe. I believe our galaxy is one of many in the universe, Shapley believes our galaxy is the universe, the only one. And then there is our place in this galaxy. Are we at the center, as I believe? Or on the sidelines, as Shapley would have you think.**

**ME:** These are really big questions! Well, I don't want to take up too much of your time. I know you are speaking next on the stage. I look forward to this debate. Thank you for talking with us today.

**HC:** **My pleasure.**

**[Time travel music]**

**ME:** Wow. That was incredible to travel to the moments before Shepley and Heber took the stage, before their history-making debate! So many crazy huge questions. So who do you think was right?

**[ENDING MUSIC]**

That does it for this first lesson! Thank you for joining me. Over this course, we will answer some of these big questions, and return to the Great Debate to learn who was right, and who was wrong.

**ME:** Now that you've finished listening, please complete the attached worksheet to go with this lesson that will help you sort out the case that Shapley and Curtis each made.

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ME: Once again, this has been our first lesson of Cataloging the Universe. Next time, we're going to look up at the sky outside our own house, and learn to take some careful observations about what we see up there. We'll see you then!