Properties of Stars Activity – Sep. 20

- Do this in a group of 2 – 4 students. Print your names and EIDs in the upper left of the *lined* side of the card, and put your responses on the same side of the card.
- Make two columns. On the left, list at least 3 stellar properties that are **intrinsic** to the star (depend only on the nature of the star itself). On the right, list at least 3 properties that depend on **both** the star *and on the observer*, which we will call **relative** properties.
- For the properties you classified as **relative** properties, explain why you placed them in that column. On what property of the observer might they depend? (You can use the back of the card if necessary.)

Commonly-Mentioned Intrinsic Properties

Property	# of mentions
Temperature	44
Luminosity	41
Radius/Diameter	31
Mass	29
Composition	11

Mentioned 5 times or fewer: age, rotation, angular momentum, color, speed or velocity, energy

Other properties were incorrectly listed as intrinsic, perhaps because of not knowing what the term meant.

Errors and Misconceptions

- "Luminosity depends on the distance at which the star is being observer." Incorrect. Luminosity is an ***intrinsic*** quantity: the total power emitted by the star as light. The fact that it appears in an equation with distance does not make it a relative property.
- "Distance remains the same regardless of the observer." Nope! The distance to a star obviously depends on where the observer is looking from.
- "Each property we classified as relative – gravity, distance, flux – affects the observed frequency." I have *no idea* what this means; it's gibberish.

Commonly-Mentioned Relative Properties

Property	# of mentions
Apparent brightness	48
Distance	23
Doppler effect/shift	16
Gravitational pull	15
Angular size	13
Position in sky (angle)	10

Mentioned 7 times or fewer: parallax, color (see below), rotational shift, radial velocity

Unclear or Confusing Terms

- "Magnitude" is too vague; it could refer either to apparent magnitude, which is a way of expressing apparent brightness, or absolute magnitude, which is an alternate scale for luminosity.
- "Size" is also an ambiguous term. I think most groups meant physical size – radius or diameter in meters, km – but it could also refer to angular size.
- "Speed" and "velocity" are similarly ambiguous.
- "Energy" was listed as an intrinsic property, but I don't know what was meant.

Errors and Misconceptions

- Several groups listed "frequency" and "wavelength" as intrinsic. These are properties of light, photons. They *don't make sense* as properties of stars.
- "Rotation meaning the side [direction?] to which the Sun [this isn't necessarily the Sun!] moves to." This clearly does depend on the ***viewing angle***.
- "Speed with which it is moving," listed as intrinsic. Speed can only be measured relative to a reference point, so it has to be a relative property.
- The above also holds for "position in space," which isn't meaningful without a reference frame.

Confusions and Clarifications

- The Doppler shift was correctly classified by most as a relative property, because it depends on whether or how much of the star's velocity is along the line of sight. However, it does ***not*** depend on distance.
- Most groups didn't understand what flux is. Flux is a quantitative measure of apparent brightness: it's the light energy arriving at the Earth per unit time and surface area. Its units are W m^{-2} = Joules s^{-1} m^{-2}.
- One card listed both apparent brightness and "visible light given off, depends on distance away" as relative properties. From the quote, these sound the same.

Clarifications and Confusions

- "Apparent luminosity." This is self-contradicting. Luminosity is a well-defined, intrinsic property.
- "Relative size … delayed information." Size relative to what? And what's the delay about?
- Several groups classified "color" as intrinsic, others called it relative. For typical nearby stars, the color is essentially intrinsic, determined by the temperature of the star's surface, which fixed the shape and wavelength peak of the thermal spectrum. Only stars that lie lying behind large amounts of interstellar dust have their colors altered, so they look redder.