Ages: 8 – 10 years old

SCIENTIFIC CASE:
Night sky constellations[1]

Team members

Writer: ______________________________

Equipment manager: ______________________________

Reader: ______________________________

Spokeperson:______________________________

Artist: ______________________________

Context

For a long time, we thought the stars high above were fixed on a motionless dome. We know now that they are turning around the center of the galaxy, like us, at huge distances one from the others.

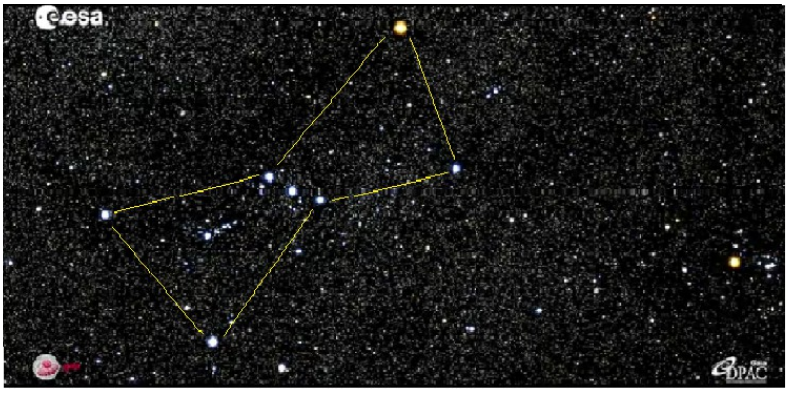
Understanding those distances is not an easy task. Imagine our Sun reduced to the size of a grain of sand. The farthest planet, Neptune, would be roughly four meters away. The first star we can find, Proxima Centauri, would be around 30 km away, like the distance between Madrid and Alcalá de Henares. Sirius, the brightest star in our night sky, would by twice as far, using this scale, this would get us the mountain region in Madrid! Wrapping our head around this concept of distances is complicated, instead, we can create very precise maps for these and many other stars.

Gaia is the name of a spacecraft from the European Space Agency. It was launched in December, 19th of 2013 from Kourou, the European space port in the French Guiana.

The *Gaia* satellite is trying to map in 3D the stars from our galaxy, the Milky Way. The used technique is called astrometry, in which the following characteristics are measured for the stars: their positions, their distances and their proper motion (stars change their position on the sky because they are moving with respect to the Sun).

1 *Educational material manufacturated by "Asociación Planeta Ciencias" under the initiative and coordination of the European Space Agency inside the CESAR program framework.*

Let's go out to look at the stars during any particular night. For sure you have imagined up there pictures of animals, people, objects… by joining the sparkly dots. Those are called **constellations**. Do you know what they really are?



http://www.esa.int/Our_Activities/Space_Science/Gaia/The_future_of_the_Orion_constellation

More educational resources:

CESAR project: http://cesar.esa.int/

Orion constellation:
http://www.esa.int/Our_Activities/Space_Science/Gaia/The_future_of_the_Orion_constellation

ESA Kids: http://www.esa.int/kids/en/home

CESAR booklets: http://cesar.esa.int/index.php?Section=Booklets&ChangeLang=en

Mission 1: Study of the stars in a constellation

Hypothesis

Are the stars of a constellation the same size?

Equipment

- Pencil.
- Rubber.
- 5 balls.
- 5 sticks of different lengths, plus a support.

Procedure

1. Every member of the team picks up one of the balls and puts a stick through it. Each "star" can have a different size.
2. Put them all together on the table.
3. Decide as a team how you want to move and order the "stars", while trying to form a picture of anything you like. This will be your constellation.

What shape does your constellation have? Draw it:

4. Now, **without touching the "stars"**, turn around the table and look at your constellation from another point of view.

What shape does your constellation have now? Draw it:

Result and conclusions

Can you move the "stars" around until you see them having the same size? Can you cover a big "star" with a smaller one? How?

Mission 2: Distances among stars

Hypothesis

Do the pictures on the stars always remain the same?

Equipment

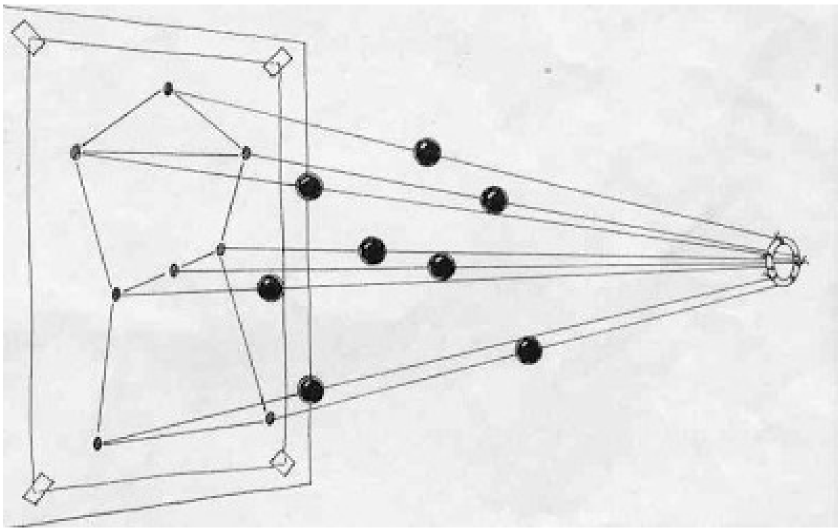
- Thick cardboard.
- Adhesive tape.
- Glue.
- Graver.
- Soft mat.
- Picture of a constellation.
- Thread.
- Wooden beads.
- Card of clues.

Procedure

You are going to build a constellation in three dimensions (3D):

1. Glue the picture of the constellation to the thick cardboard. Put the cardboard on top of the soft mat and puncture a tiny hole for every star.
2. Pass a portion of the thread through each tiny hole, let it hang on both sides. Turn around the cardboard and tie a knot for each thread. Then, put some adhesive tape to prevent the thread from sliding out.
3. Prepare the cardboard face up and string one wooden bead per thread. String again, on the same direction away from the cardboard. When the thread is tighten up, each bead stays fixed. When the thread is hanging a bit loose, the bead may slide to the point of your choosing.
4. Now every team member has an extra role to play:
   - two of you shall hold the cardboard on each side,
   - two of you shall hold the threads as tighten as possible,
   - the last one reads the card of clues and supervises.

5. Follow the instructions of the card of clues, sliding the beads closer or farther apart from you. <u>Be careful</u>: The stars of a constellation are named with Greek letters (alpha, beta, gamma…) Sometimes they also have a proper noun.
6. Whenever you finish, you have a toy model for a constellation in 3D. If you have any doubts, ask for help to the educators.



7. Check the results from the rest of the teams.

Result and conclusions

Do the picture of the stars look the same to you from every perspective?

Can you see the same constellations on Earth and on every other planet from the solar system? What about on a planet that orbits a different star?

Why do we see some brighter or bigger stars than others?

Inside the galaxy, stars turn around the center. Will the constellations change as time passes by?

Look at the video about “The future of the Orion constellation” [link in *Context* seciont].
Why do you think that happens?

Research equipment

CONSTELLATION 1: The Big Dipper (Ursa Major)

- The closest star is **Megrez** and right behind is **Alioth**.
- **Merak** is farther away than Alioth.
- Merak is followed by **Pecda** and **Mizar**, just slightly farther away.
- Behind Mizar, you will put **Alcor**. A bit farther away, there is **Dubhe**.
- The farthest star is **Akaid**, almost touching the cardboard.

CONSTELLATION 2: Ursa Minor

- The closest star is **η** and two fingers behind there is **β**.
- The farthest star is **γ**, two handspands behind **η**.
- **Polaris** (or **α**) can be found just in the middle between the previous ones.
- The star **ε** is slightly in front of Polaris, and **ζ** just in front of **ε**.
- Lastly, the star **δ** is just slightly closer than **γ**.

CONSTELLATION 3: Cassiopeia

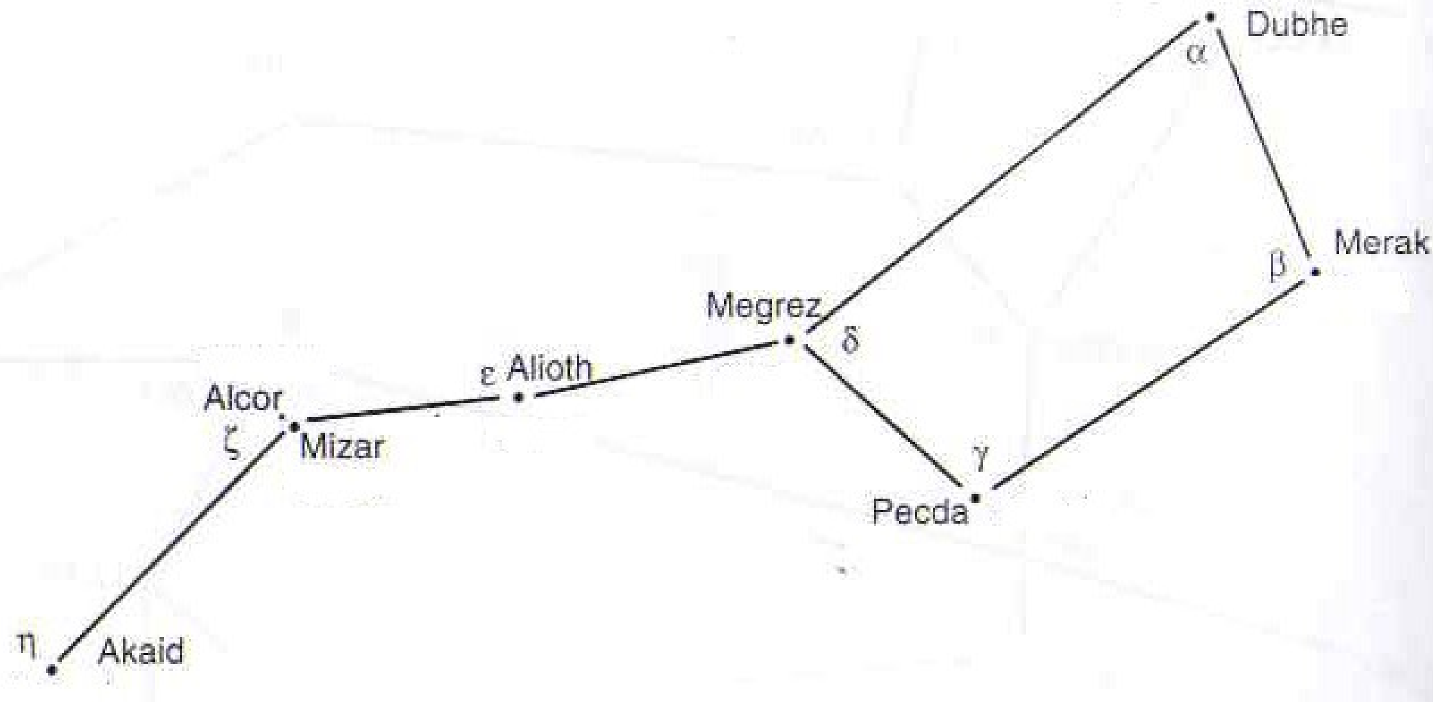
- The farthest star is **ε**, you will put it two handspands from the person holding the threads, touching the cardboard.
- You will put stars **α** and **γ** half way that previous distance.
- The closest star is called **β**.
- Midway between the closest stars and the two that shared the same distance, you will fix star **δ**.

CONSTELLATION 4: Orion

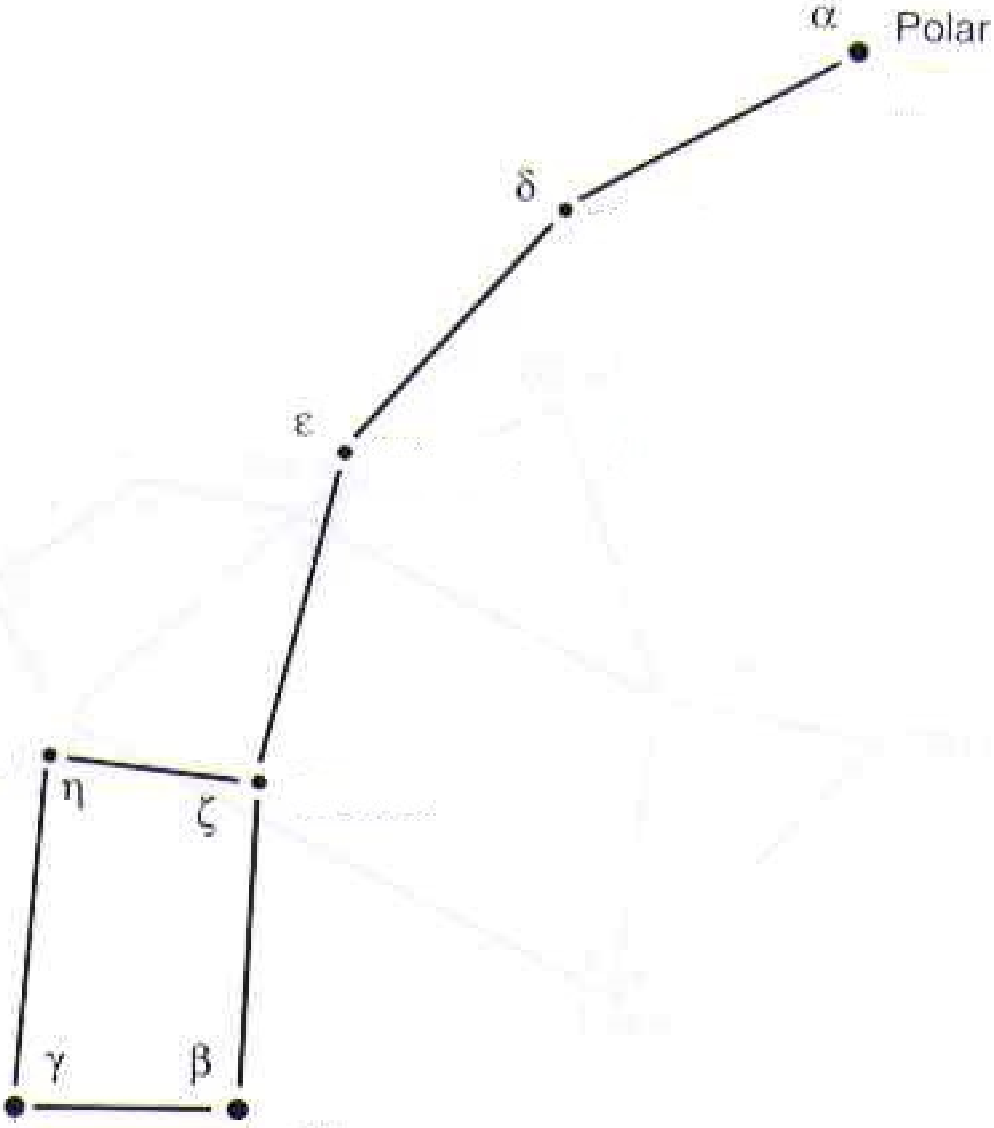
- The farthest star is **ε** (at the center of the belt), and the closest one, **Bellatrix**, are separated four handspands.
- Midway between both, you will put star **Betelgeuse**, and midway between this and the person holding the threads, you will put star **ζ**.
- Star **Rigel** is two fingers closer than star **ζ**.
- Star **δ**, from the belt, is at the same distance as Rigel. Finally, you will put **Saiph** a bit closer.

CONSTELLATION 5: The *Teapot* (Sagittarius)

- The farthest star is **φ**. You can measure the distance separating this from the closest one, **λ**, as two handspands.
- Midway between both, there are the stars **γ** and **ζ**.
- A couple of fingers farther away than **γ** and **ζ**, you can find the star **ε**.
- In front of **γ** and **ζ**, on the half part closest to the person holding the threads, you can put star **τ**.
- In front of star **τ**, the stars **δ** and **σ** are one finger apart.



Dubhe
α
Merak
β
Megrez
δ
ε Alioth
Alcor
ζ
Mizar
γ
Pecda
η
Akaid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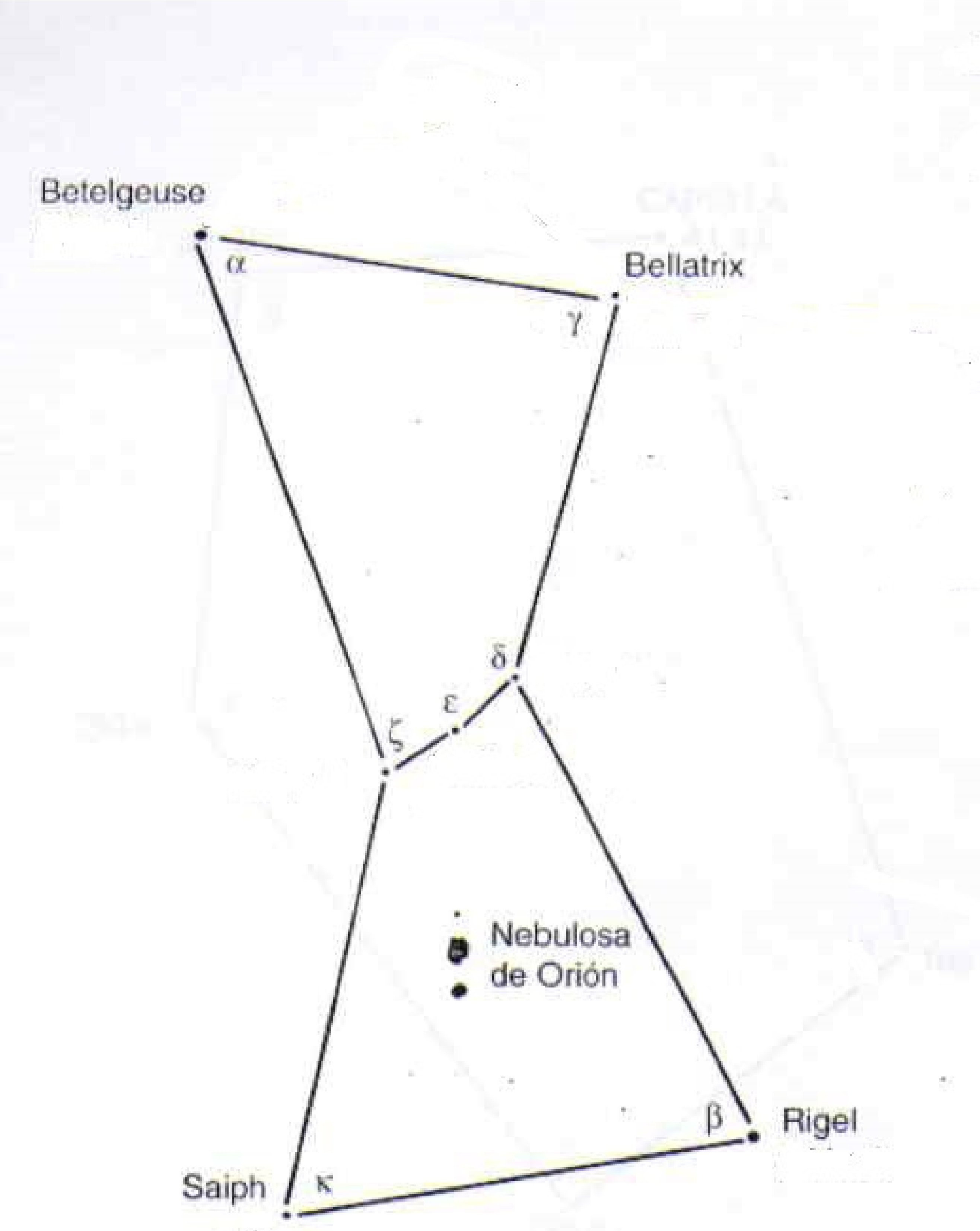
Betelgeuse
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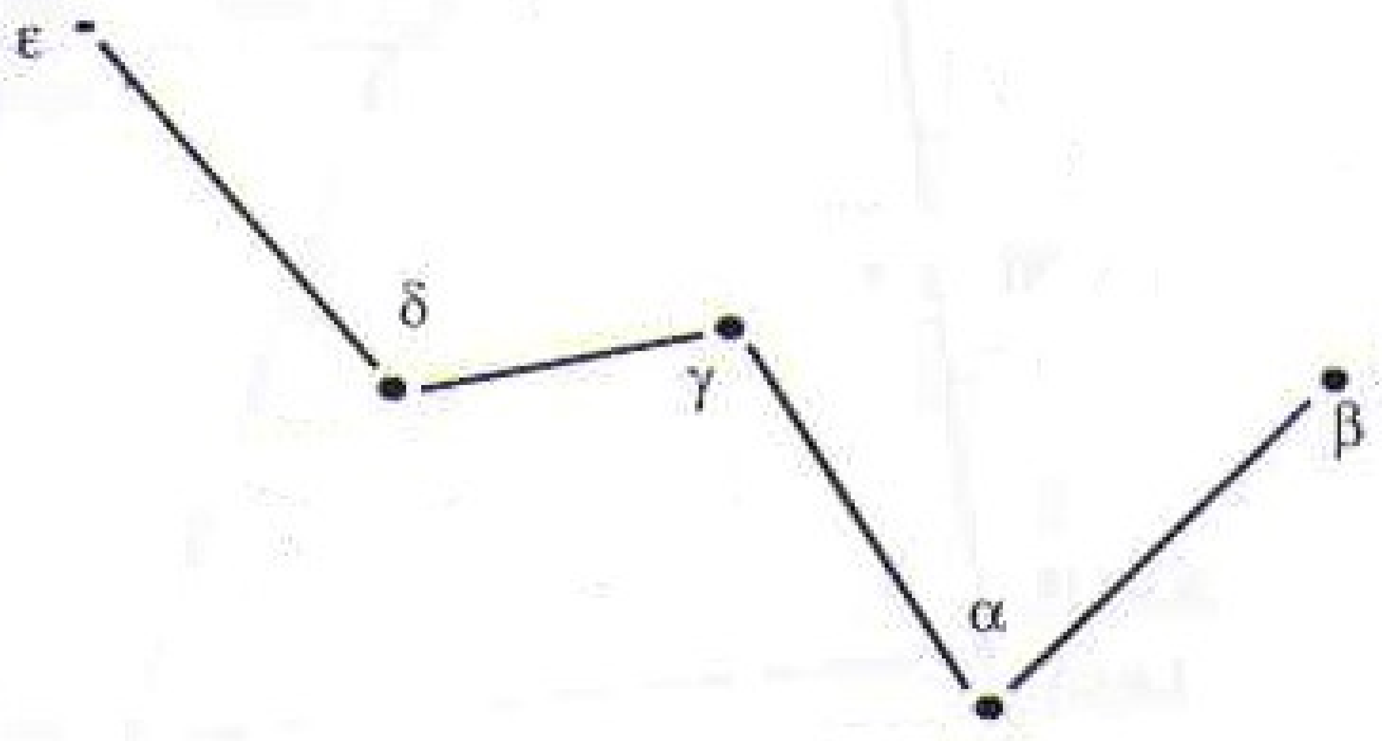
β
Rigel
Saiph
κ


ε
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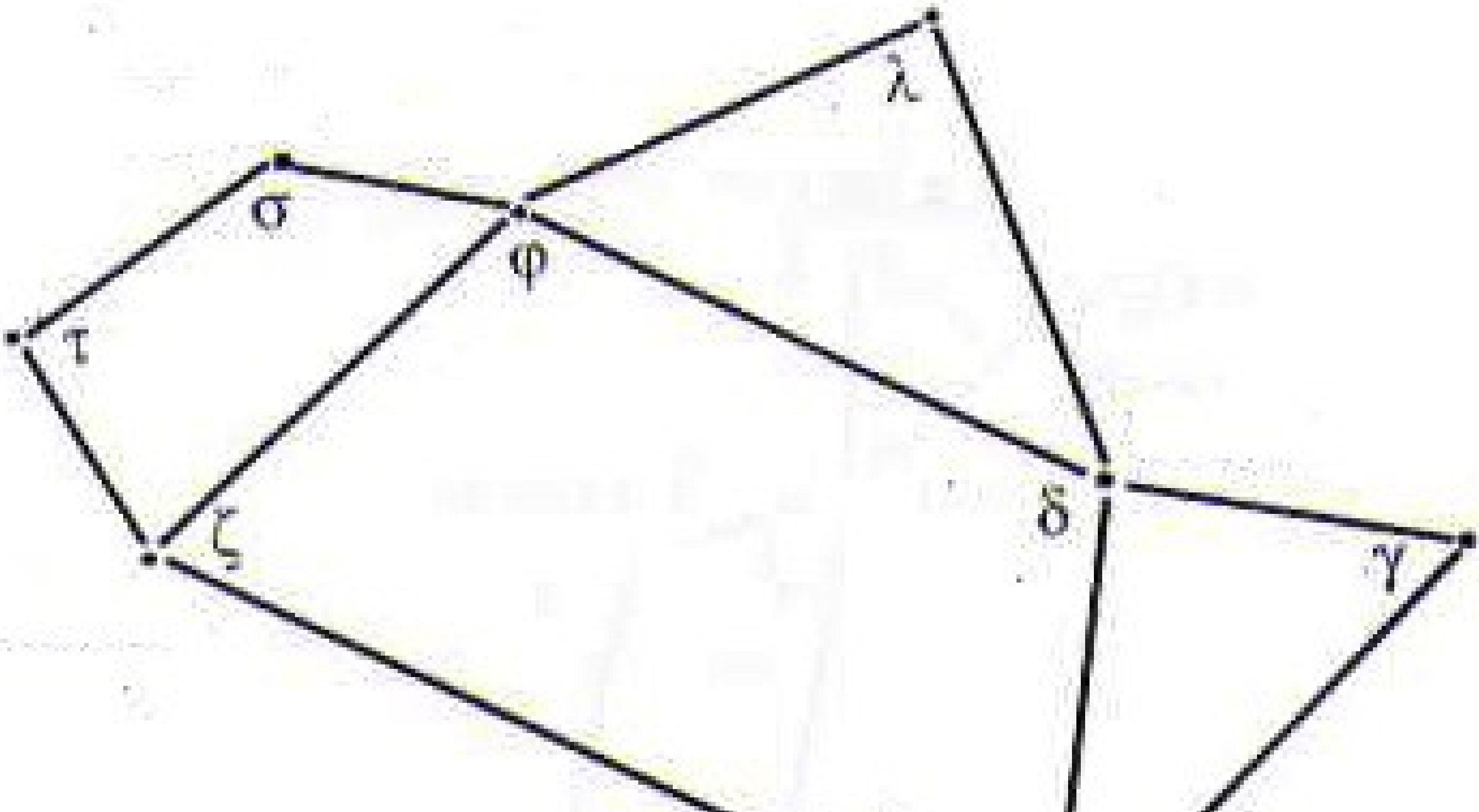
λ
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