

Royal Astronomical Society of Canada

Double Star Observing Program Guide

18 October 2020

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RASC National Observing Committee

“Double stars offer some of the most attractive sights around and they are particular good in small telescopes where the colours are much more obvious.”

-- Bob Argyle, *Observing and Measuring Visual Double Stars*, 2nd Ed.

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Introduction

Welcome to the RASC Double Stars Observing Program. It encourages observers to view a variety of double and multi-star systems. As noted in the RASC *Observer's Handbook*, 85% of stars are double or triple systems. This program is aimed at the intermediate visual astronomer. Those who complete the program may apply for a certificate.

This program will:

- Nurture interest in double stars.
- Present an array of interesting double stars.
- Reinforce good observing practices and techniques.
- Encourage active observing programs in RASC Centres.

The Double Stars Observing Program may be completed with a small telescope, with an objective size of 90mm. However, a large telescope, if available, may reveal additional elements. For example, what appears to be a simple double may, in fact, be a triple or a quadruple. Using different magnifications is recommended.

Observers may enjoy viewing from urban locales, and during periods with a bright Moon, as double stars can generally be viewed from anywhere and at any time of the month. While dark adaptation is helpful, a dark site is not a requirement. Atmospheric seeing can impact double star viewing, but all the target doubles can be viewed under moderate or better conditions.

This program guide is provided to assist the amateur astronomer in getting started with double star observing. It will provide some instruction on how to effectively observe double stars.

Double star observing has a long history with the first recording in 1617 with Mizar determined to actually be two stars. Friedrich Struve (STF, Σ), Sherburne Wesley Burnham (BU, β , not to be confused with the beta star), and William Herschel (H) visually observed a great number of doubles in the 1700s and 1800s.

For the balance of this document, we will only use the term double stars.

Program Details

The 110 double star targets are visible from the northern hemisphere across a wide sample of constellations. The list should present few difficulties for observers between north latitudes 40 to 50 degrees. The program can be started at any time and can be easily completed within 12 months. Only 110 pairs must be observed.

Typical double star lists show separation, position angle, colours, and magnitudes. The RASC double star program departs from this convention to help observers view targets without preconceptions. With only coordinates and combined brightness, it allows the observer to “discover” the nature of the double star on their own without any bias. If the observer prefers to know in advance the details of each target double, they may use the Supplementary list.

A certificate will be awarded to a RASC member who visually observes all 110 pairs on the official Double Stars Observing Program list as published.

See the Double Star lists section for the various file types available and obtain the double star checklist in your preferred format (e.g. SkySafari).

Many observers obtain Sissy Haas’s book listing 2100 *double stars for small telescopes*. Some like the *Cambridge Double Star Atlas*. There are a number of useful online tools. See the RASC general observing tips web pages.

The RASC Double Stars Observing Program was launched in 2020.

Contact the Observing Committee Chair [observing@rasc.ca] if you have any questions or comments about this or our other certificate programs.

Program Requirements

This guide includes examples of both textual observing notes and representative sketches, thus giving you examples of what you might see and how to best present your log notes in order to earn the certificate. Suggested terminology is also provided.

Use the provided pre-filled log sheets with sample form and sketch. If you prefer to set up their own observing logs, review our forms so as ensure you capture the necessary information. We require detailed indications of what you saw.

Briefly, for each double star, document your impressions. Does it look like a double or a triple? Describe the main pair of stars, their distance from each other and angle in the eyepiece. Observe the colour and brightness of each star. Optionally, make a simple sketch to accompany your description.

After reading this guide, with the checklist or electronic observing list, you can then start recording your observations.

Complete the program by traditional star-hopping or with assistance of a GoTo telescope.

All 110 program targets must be observed. None are optional. Observe the obvious pair of stars; we do not expect you to provide details of every pairing visible in the field. In fact, without a computer at your side, you would not be able to specifically identify all of the stars in a multiple star system. If desired, review the double star supplementary sheet.

Using different magnifications with double stars is highly recommended.

The Main Checklist

The Double Stars Observing Program list is provided in different file formats. See the Double Star List section for more information. It contains 110 entries. You may use the checklist in PDF form or as an Excel file. These files are organised by season and then sorted (in general) by Right Ascension.

The main checklist does not show individual magnitudes, colours, position angle, or separation values.

The following columns are noted:

- Target: a common name for the target double star or multi-star system
- Alternate ID: other designation for target including Bayer, Flamsteed, Draper number, etc.
- SAO: Smithsonian Astrophysical Observatory star catalogue designation
- HIP: Hipparcos star catalogue designation
- WDS: Washington Double Star catalogue designation (the official double star ID)
- Con: host constellation
- MagC: **combined** magnitude of the stars
- Mm: recommended telescope size, objective aperture in millimetres
- X: recommended power or magnification
- RA 2000 and Dec 2000: rounded coordinates for the target using J2000 values
- PSA: the page number from the *Pocket Sky Atlas*
- Seen?: use check box to indicate target was viewed

The list has also been made available for a couple of software applications, SkyTools and SkySafari. In software apps, you can sort objects to your liking and apply filters so to show a short list of targets visible for a given evening.

The Supplementary List

A second, separate detailed list of stars is provided for observers wanting more assistance. It notes additional pairs associated with each target, as many double stars are actually multi-star systems. You are not required to view or log the additional pairs—they are optional.

The following columns are noted:

- Target: the double star target name, matching that in the main checklist
- Parent: the discoverer code for the main pair, e.g. STF 100 for Struve's 100th double star
- Disc. ID: WDS Discoverer ID designation, may be different from parent, STFA 999, Struve appendix entry
- Pair: the letter codes indicating the specific pairs of stars, e.g. AB, AC, AD, etc
- Last PA: the latest measured position angle in degrees (°)
- Last Sep.: the latest measured separation in arc-seconds (")
- Mag. 1: the magnitude of the first star in the pair
- Mag. 2: the magnitude of the second star in the pair
- Notes: descriptive notes for the pair, indicators for interesting nearby neighbouring objects
- Type: indicator of the type or class double star, e.g. Physical, Binary

If the "pair" is blank, it means there are only 2 stars in the system.

The types of double stars are:

- Binary: stars orbiting one another
- Physical: related stars close enough to be affected by each other gravitationally
- Optical: stars far apart but coincidentally aligned so to appear close together
- Uncertain: When there is insufficient data to determine the type

Pairs with separations less than 1.0 arc-seconds were omitted. Stars dimmer than magnitude 13.0 were omitted.

All data are from the Washington Double Star database as of August 2020. If you compare these numbers to other sources, you might see discrepancies. Differences can be due to many factors. Consider the WDS to be the official source. Visit the site for accurate and current values.

Double Star List Files

The target list (and supplemental table) are available in a variety of formats:

- printable .PDF forms
 - main checklist [\[link\]](#)
 - supplemental list [\[link\]](#)
- SkyTools observing list .STX file [\[link\]](#)
- SkySafari observing list .SKYLIST file [\[link\]](#)
- editable Excel workbook .XLSX files
 - main checklist [\[link\]](#)
 - supplemental list [\[link\]](#)

Using electronic formats allows sorting and filtering.

Certification

A certificate will be awarded to a RASC member who visually observes all 110 main pairs on the official Double Stars Observing Program list.

The program may be completed by traditional star-hopping or with a GoTo telescope.

Applicants may complete the provided log form or provide their own notes with appropriate details.

Applicants will provide their completed log notes, with application form, for review to two of their local centre observing representatives, or to a member of the national observing committee.

As in all our observing certificate programs, we encourage applicants to take their time, work slowly and carefully, without rushing, and enjoy the view. Also, sketching is strongly encouraged.

Recording Observations

Download the Double Star Observing Log Book with 110 pages, pre-filled with the target names and coordinates. It also contains a sample page with a detailed observation and a tips page.

RASC Double Star Observing Program Log Book

SAMPLE COMPLETED FORM

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target	Psi	alternate IDs 36 Cas, SAO 11751, HIP 6692, BU 1101A					
constellation	Cas	combined mag.	3.5	RA (2000)	01h25m56.2s	Dec (2000)	+68°07'49"
date	7 Oct '11	time	11:40 PM	time zone	EDT		
location	"The Overlook", Toronto High Park, from the south-facing porch, with black blinds installed!						
telescope equipment used	Celestron C8 SCT, Vixen Super Polaris, RA motor for tracking, star hopping						
eyepieces, magnifications used	Baader 36mm (55x), Celestron Plossl 26mm (77x), Tele Vue 9mm (226x)						
first impression of target	<u>double</u>	multiple	Moon phase		●●●●○●○●○●○●○●○●		
general appearance of entire system	neat star field, lots of faint stars, reminds me of Polaris						
pair designations	A	AC	CD	AB			
orientation	-	south-east	south	?			
distance	-	wide, easy	half AC	?			
brightness	bright	faint	fainter than C	beyond 8"			
colour	pale yellow	blue	pale white	?			
sky conditions, particularly seeing	warm, 70% humid., poor seeing			sky location, part. altitude	NE, high, 60° elevation		
other notes, remarks, comments	<p>Nice. Easily separated at low power. Main star is easy but companion, while widely separated, is very faint. Main is yellow. Companion waffles between deep blue and green! I know it can't be green! Amazing colours. Would not tolerate magnification higher than 77. Haas says there's a B star so I plan to revisit... Hold the phone. SkyTools says B is mag 14.3! OK, maybe not...</p> <p>Update: From the Washington Double Star database... magnitudes: A 4.7, B 14.0, C 9.2, D 10.0 other designations: HV 83 in fact, Herschel was the first, saw AC stars, in 1782!</p>			<p>what I saw</p> <p>W → SCT 0' 9mm MD.</p> <p>Gelky 2B</p>			

One need not use the paper sheets or pages of the log book directly. You may use your own logging method, format, and conventions. Still, review the double star specific items "prompted" for in our log book pages.

Standard observing log book items include date, time, time zone (local or UT), location, equipment used, weather conditions, the Moon phase or lighting, general notes, remarks, and comments, and a sketch.

When describing a pair of stars, remember to note:

- Pair letters or description. You may say “main” and “secondary” and “tertiary.” Official catalogues use AB, AC, AD, and so on. Software tools can help with official star designations. Sometimes a pairing will not use the A star. If D is very close to C, the convention is to use CD.
- Orientation. For the position of the second star to the first, use compass directions if possible, e.g. NW. Or use a clock face, e.g. 3 o’clock. Formally, this is the Position Angle, PA, or theta (θ) measured in degrees ($^{\circ}$).
- Distance. For distance or the angular separation, indicate how far the stars are from one another. Consider casual descriptions: rod-shaped, figure-8, touching or kissing, split by a hair, a tiny gap apart, tight, close, fairly close, wide, very wide, super-wide. You can compare to other stars. “C is twice the separation of B to A.” Formally, this is the Separation or rho (ρ) measured in arc-seconds (").
- Colours. For colours, try to use well-known terms: blue, white, yellow, orange, red.
- Colour strength or saturation. Use very intense, intense, medium, pale, very pale.
- Brightness. Use very bright, bright, average, faint, very faint. Formally, this is magnitude.

Specific things expected in double star observations:

- Eyepiece magnification used. Typically, many different magnification levels are used or perhaps a zoom eyepiece. Was a Barlow or PowerMate or reducer or flattener used.
- Was a mirror or star diagonal used. It will flip the eyepiece field.
- Your first impression of the double star target. Remember 85% of stars are double or multi-star systems. Many targets have more than 2 elements, although some may be too faint or too close to resolve or split clearly. Circle the appropriate label: if a simple pair, circle “double.” If a triple star or quadruple star or many stars in an open cluster, circle “multiple.”
- General appearance. Describe the field around the target. Lots of stars or a void. Any nearby doubles?
- Sky conditions. In particular, note the seeing. Poor seeing can degrade the resolution of the view. Excellent seeing helps one spot faint stars or split stars at or below the telescope’s Dawes Limit.
- Height of the target. Use elevation or altitude in degrees, e.g. “about 45° up” or “nearly overhead.” Or note the air thickness or air mass value, e.g. “very low, looking through more than 2 airmasses.” When observing through more air, it may be difficult to split tight pairs. Star colour may be reddened.

When a target itself is an assembly of a few stars, they may be in an evocative pattern or shape. Or perhaps you observe a simple pair in or near an interesting pattern. Describe what you see. Note shapes or patterns for stars, e.g. right-angle triangle or “at the end of a long arc of dim stars” or a “hockey stick of three stars.”

Sketching will train you to be a better observer. When you sketch, remember:

- to add the target name
- note the eyepiece or magnification and mirror diagonal
- note two cardinal points, such as West and North or East and North.
- use large discs for bright stars and small dots for dim stars
- include any other relevant information

Examples

We include some double star log book examples for your consideration.

Located Trapezium easily with 32mm. Switched to 17mm (164x) to sketch but best view was with 32 (87x). B east of A, C to the NNW, D east of C. All stars bright white. Nebula was bright, almost glowing! I tried to separate more doubles using 2x barlow but was not successful. My eyes feel tired tonight. Temp 0°C when I went out and -5 two hours later. Very little breeze. Zodiacal light in west.

First look: Wide double. Pretty at low power. I think the main star is white or pale yellow. Companion: colourless...? 25 May '08. Second viewing: a pleasing, easily-split double at low power, 52x. The main star is yellow-white and bright; very faint companion is pale blue. Roughly estimated the PA at 220°. 7 Mar '09.

Triple. Nice. Interesting. Yellow star. North-west, very close, an orange star. B. Nearly empty field. Neat triple with colourful stars. -2.5°C, 20% humidity. Skies better than last night. No wind. Viewed on evening of 17 Mar '18 with the C8.

After a disorienting star hop from Deneb, finally landed on target. Absolutely amazing colours. I don't know if I've ever seen a star so blue! Easy wide stars. Dimmer, to the south, very wide. Viewed on evening of 30 Jun '19 with ETX 90. Second look: We enjoyed the deep blue and orange and white stars. Viewed with GSO 16 on 5 Jul '19.

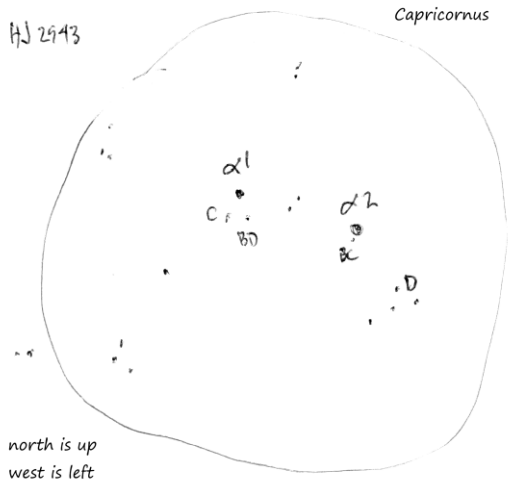
A colourful pair. Golden and aquamarine. Very tight. Nearly oriented east-west. The east star looks brighter, by a small amount. Low humidity, cool conditions. Felt good tonight. Eyes working well! Viewed 10 Jul '19.

Variable star U Sgr aka BU 966. Inside Messier 25! B is closest bright star (while wide) to west-west-south. There is another companion. According to my software its designation is "U". But the B and U stars were merged, could not split tonight. The primary is orange. B is pale white. High thin cloud dimmed the field slightly. Viewed on 7 Aug '17.

In summary, compare the magnitude and colour of the components. Note the separation of the components in your telescope (wide, narrow, unobservable). Note the angle of the dimmer stars relative to the primary. Try different magnifications. When steady seeing allows, you may observe close to or at your telescope's maximum resolving power, in other words, split tighter doubles.

Sketching What You See

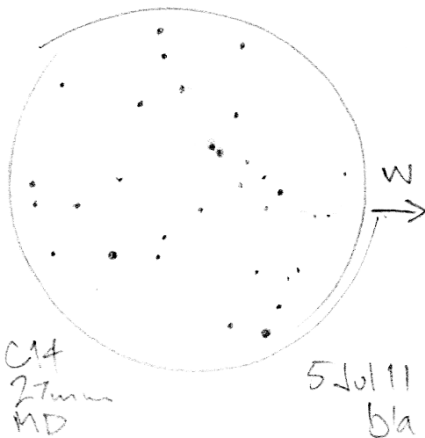
Make a quick sketch of what you see in the eyepiece. You may find it easier and faster to make a simple sketch of the positions of the stars and their brightness, rather than a verbal description, but it's your choice. It is recommended you keep a sharpened pencil and pad of paper handy.



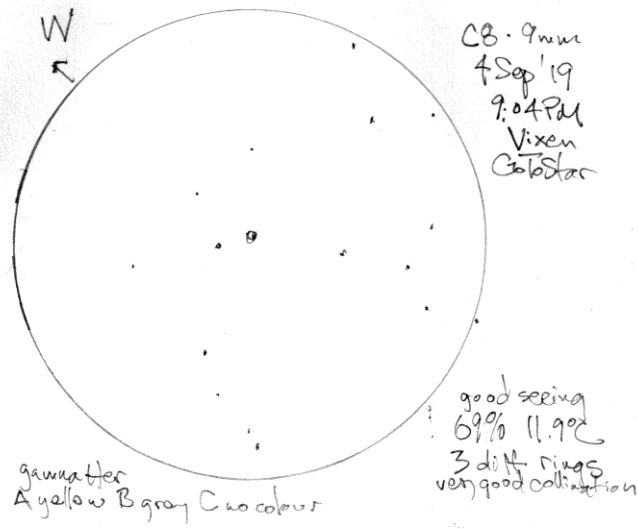
Note the sketch above does not include the telescope details, the eyepiece used or the magnification. The date and time and the sky conditions would be nice to see. If your textual notes are scant, label the star colours in your sketch.

Sketching double stars is rewarding—and helpful with difficult targets—so observers are encouraged to visually represent their observation. Sketching is not required but is strongly recommended.

36 Oph



A quick sketch may be particularly important with a complex system or within an open cluster, when there are many companions that would be fun to identify the morning after.



As noted elsewhere on our web site, sketching helps an observer see better. And seeing better helps one to become a better observer. Carefully drawn double star sketches allow for detailed analysis any time later. This can greatly aid in the identification of additional companions in a multi-star system or possibly lead to a discovery.

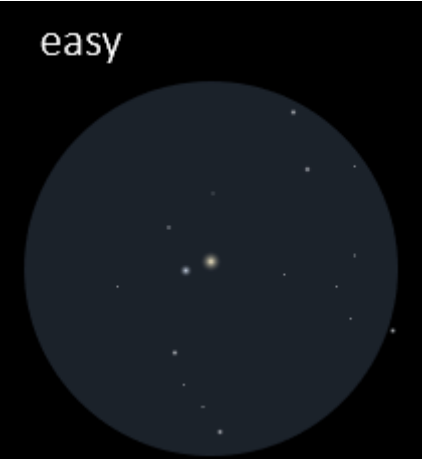

Other Activities

Imaging is not required. However, imaging of double stars is relatively easy with fast exposures and can draw out faint stars. You may include images in your log. You may not substitute an image for descriptive observing notes or a sketch.

Measurements are not required. You are not expected to quote the angular separation (in arc-seconds) or the position angle (degrees from north). Certainly, if you use an astrometric eyepiece, you may include these details. But casual descriptions for separation such as touching, tight, close, wide, or extremely wide are sufficient. Casual descriptions for the position angle such as north, north-west, toward HD 123456, or in-line with the C star, are adequate.

What You Can Expect to See

Our target list features a wide sample of doubles stars. We deliberately showcase different types. Some are wide, some close, sometimes the primary and secondary are the same, while others differ in magnitude. Some doubles are in busy fields, making it challenging to know which star is which. Verify your location when another double is nearby. Consider the magnitude. Keep good log notes to describe what you see. Make a quick sketch when there are many stars.

 <p>easy</p>	<p>Easy pair. Close to wide separation, obvious bright stars in field, faint field stars, if any.</p>
 <p>different</p>	<p>Very different magnitudes can make it challenging to see the secondary as the A star may overwhelm. Note the faint B star at the 8 o'clock position.</p> <p>If the seeing is poor, you might not be able spot the companion. It's OK, note "could not split" and try again on the next clear night.</p>

<p>tight</p> 	<p>A tight pair. At low power, the stars may touch or merge; at high power, they move apart and you may get a black line or gap between. Stars can be tighter or closer together if the same magnitude.</p> <p>If the seeing is poor, you might not be able to use high magnification. It's OK, note "could not split" and try again on the next clear night.</p> <p>A large telescope, if you have access, will offer greater resolution.</p>
<p>which?</p> 	<p>If there are many stars in the field, or the double is in the middle of an open cluster, you might not know which star is which. Verify the location. Double check the combined magnitude value.</p> <p>Sketch the scene or consult accurate astronomy software. Also, the target might be a multi-star system with a dozen identified members!</p> <p>It's OK, pick the stars that catch your eye and make up labels. If you're really lost, consult our supplemental list.</p>
<p>fun</p> 	<p>Some of the suggested targets are near other doubles. This is neat! But it begs the questions, are you on the right double?! It can be challenging, in a fun way...</p> <p>Verify the location. Double check the combined magnitude value.</p> <p>It's OK, do a sketch of the whole field noting each pair. If you're really lost, consult our supplemental list.</p>

In this program, effort was made to expose the observer to the wide variety of double stars that are available to smaller telescopes. As your interest in double stars increases, you will no doubt encounter a great many different situations.

If you struggle with what you're seeing, we offer many options to get more comfortable with double star observing. If you're consulting only the checklist, there are no details about the separation or angles, star brightness, or star colour. Should it be necessary, consult the Supplementary Sheet for detailed information on each target. Also, do not hesitate to reach out to your "double star coach" Blake Nancarrow. You may also contact the Observing Committee Chair.

Double Star Observing Tips

The mandatory dark sky conditions so necessary for deep sky objects are not required when observing double stars. Still, maintain dark adaptation as much as possible. Avoid intense or bright red lights. Double star observing can be done in moonlight. So, if good to excellent weather conditions present themselves during a full Moon, plan a session.

As with other types of observing, choose target stars that are as high in the sky as possible. Double stars low to the horizon are degraded by the additional thickness of the atmosphere. Under such circumstances, faint companions may disappear. Tight pairs may appear to jump around when seen through the turbulent atmosphere. The natural colours of the stars may be reddened.

Use different magnifications. A pair of stars simply look more pleasing when closer together, than if on different sides of the field of view. Generally, start at your lowest power. Faint companions or extremely tight partners may require high power. You might try magnifications ordinarily considered “too high,” such as 500x or 600x, on occasion. Use your doubler.

Tight pairs or unequal pairs often require good to very good seeing. Rather than skip nights with undesirable conditions, plan to view wider or more balanced pairs.

Double star observing demands good to excellent collimation. If using a Newtonian or SCT, learn to collimate it well.

Busy star fields, such as those within the Milky Way, may make it difficult to know “which star is which?” If you have good digital charts handy, you might zoom in or rotate the field to help you identify the more difficult stars. If you are not using a computer or mobile device, your quick sketch is important as, later, you can compare your rendering to a computer chart or digital image. Or have the Supplemental list at the ready.

Get to know your field of view. Learn about your telescope's presentation, whether laterally inverted (common with an SCT) or rotated (common in a Newtonian). Remember that without tracking, objects will exit the field of view to the west. Learn where north is. Also get familiar with your field sizes, e.g. a wide field aspheric 36mm eyepiece in an 8-inch SCT may present a +1 degree field, while an old 18mm orthoscopic ocular shows 24 arc-minutes.

Know the limits of your equipment. What is the magnitude limit? The magnitude limit for an 8-inch telescope is around 13 to 14. If a double star has a magnitude 15 companion, you won't be able to see it. Calculate the Dawes limit. The Dawes Limit for a 3-inch telescope is around 1.3". Doubles with a separation less than 1.0" will not be splittable. Doubles at 1.3 will likely appear as a rod or peanut. At twice the Dawes Limit, in theory, you will be able to cleanly split two (equally bright) stars. Understand how sky conditions may impact theoretical limits. If you observe in the city, avoid the glare of bright lights. Arguably, most or all the targets on this list should be visible in an urban location, but star hopping may be impossible in a bright sky.

And keep trying. Some tight double stars may be “not splittable” due to various factors: perhaps it was too low, too late, or you were tired, or the seeing conditions were quite poor. Annotate things accordingly in your logs, and make a point of returning at another time. It's OK. Most double star observers experience this and simply revisit targets.

Additional Resources

See the RASC *Observer's Handbook* for two essays: DOUBLE AND MULTIPLE STARS by Brian Mason and COLOURED DOUBLE STARS (with addendum) by Michel Duval.

<https://rasc.ca/handbook>

Sissy Haas produced a popular book called *Double Stars for Small Telescopes*. It contains over 2100 targets with descriptions. Published by Sky and Telescope.

<https://www.shopatsky.com/double-stars-for-small-telescopes>

Serious observers may wish to acquire *Observing and Measuring Visual Double Stars*, the second edition, by R.W. Argyle. Published by Springer, this is a more technical work.

<https://www.springer.com/gp/book/9781461439448>

Professionals, amateurs, and students regularly produce reports and papers on double stars and multi-star systems. Many of these are made available through the *Journal of Double Star Observers*.

<http://jdso.org/>

Note eyepiece magnifications in your double star observing notes. See the *Sky & Telescope* web site for their online calculation tool.

<https://www.skyandtelescope.com/observing/skyandtelescope-coms-scope-calculator/>

There is much activity on the Cloudy Nights Double Star Observing online forum.

<https://www.cloudynights.com/forum/86-double-star-observing/>

See the excellent Double Star Astronomy section in Bruce MacEvoy's web site. He discusses getting started, how to "train" your eye, star colours and so forth. He also co-produced the well-regarded *Cambridge Double Star Atlas* (second edition!) with lists and charts.

<https://www.handprint.com/ASTRO/>

The official source, and warehouse, of multi-star data is kept at the Washington Double Star (WDS) catalogue. As of August 2019, there were over 145 000 pairs listed. Managed by the US Naval Office, the database is currently available at the Georgia State University.

<http://www.astro.gsu.edu/wds/>

Program Feedback

The RASC Double Stars Observing Program was launched in 2020.

The Observing Committee has rigorously checked the content of this certificate program to make it as accurate and complete as possible, but there may be issues, errors, or omissions.

Blake Nancarrow, a double star fanatic with over 1600 splits, is the founder of the program. He is ready to receive your feedback and offer assistance. Contact him [astronomy@computer-ease.com] if there is anything confusing or unclear or with any questions about double stars (accolades or suggestions are welcome).

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