Canadian Astronomy Education
A project by the Canadian Astronomical Society/La Société Canadienne d'Astronomie

Teacher's Guide to the Canadian Junior Astronomer Program

In a time when more and more material seems to be packed into the curriculum to be covered in a year's time, teachers often face the temptation to place more onus on the students to learn material not thoroughly covered in class. The Canadian Junior Astronomer Program presents students with the opportunity for independent learning, while complementing the material covered in class. Read on to find out how this exciting new program can be used in your science class!

Background

The inspiration for the Canadian Junior Astronomer Program (CJAP) came in part from the demands of the new science curriculum, as outlined in the Pan-Canadian Science Protocol, and in part from the Observing Certificates created by the Royal Astronomical Society of Canada (RASC), in an effort to encourage amateur astronomers by giving them starting points and observing goals. There are three levels to the program – Star, Nova and Supernova – catering to the experience of the student in the subject. After this, the students are encouraged to try the RASC's Explore the Universe Certificate.

The Reasons for Choice

Research into best practice teaching techniques is pointing more and more toward offering the students a choice. Not only does choice naturally cater to the different learning styles of every member of a class, but it also draws upon the talents of each individual, encouraging them to express themselves in a way that is comfortable and appealing to them. Throughout the three levels of the CJAP, the students are offered choice in what they observe and research, as well as how they present some of their findings.

Using the Program in Class

It is recommended that all elementary students begin with the Star level, and perhaps complete this as a class project. The higher levels are then available as optional continuations of the project, to be completed for bonus marks or simply to further encourage students who particularly liked the first level. Secondary students might combine the first two levels as a project in class, leaving the third as supplementary material. All three levels are designed to be student-friendly and do-able by most students.

Each level has three components: Observing, Thinking and Extensions. They need not be done in any specific order, and there is choice in each component as to what tasks the student completes.

1. Observing – This component allows the students to do some actual "stargazing," by getting outdoors and drawing what they see in the sky. This may be done as a class field trip or "star party," or individually from each students' own backyard. There are enough observing targets that this can be started at any time throughout the year, and most can be seen even in large cities (although darker skies do help considerably!).

2. Thinking – This component can be completed based on notes taken in-class, or based on independent research via textbooks, a library period or on the Internet. Students are encouraged to seek out the answers to questions about the nature of space or other aspects of Earth and Space Science.

3. Extensions – The final component combines some observing tasks, some thinking tasks as well as engages the student creatively in how they present their work. This section will offer tangible results that can be displayed in the classroom as the students complete the project.

The End Result

What project would be complete without the reward of completing the given tasks? When your students have finished any of the levels, email their names, the school address, and level(s) completed to cascaed@astro.utoronto.ca . Their names will be added to the list of students on the Canadian Astronomy Education Website who have already completed certain levels of the program, and certificates will be sent to the school to be presented in class or at an assembly. Of course, the greatest reward is the knowledge gained, and the new appreciation for the night sky!

Last Words

In this teacher's package, you will find descriptions of the levels and the tasks for each, checklists to help manage class projects, a sample observation recording form (these could be made into "observing logs" for the students if you wish), a list of online resources, and rubrics for evaluating student work based on the project. If you have any questions, concerns, comments or suggestions, please let us know at cascaed@astro.utoronto.ca . Best of luck, and clear skies!

Star Level:
Master Task List

Part A: Observing*
(complete any 2 of the 6 tasks below)

1. Draw the Big Dipper asterism (year-round)
2. Draw the constellation Cassiopeia (year-round)
3. Draw the constellation Orion (November through March)
4. Draw the constellation Cygnus (June through November)
5. Draw the constellation Hercules (May through October)
6. Draw any two constellations from the Zodiac**(counts as two tasks; year-round)

*Use the observation recording form in this package, or create one that contains the same information.
**Zodiac constellations are: Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpio, Sagittarius, Capricorn, Aquarius, Pisces

Part B: Thinking
(complete any 2 of the 7 tasks below)

1. Locate your nearest planetarium, observatory or astronomy club. What is its name, and where is it?
2. What is a lunar eclipse? When will the next one be visible from your area?
3. Why is it coldest in January, when the Earth is actually the closest to the Sun?
4. What is a comet? Where do they come from?
5. Why do we have leap years? When will the next leap year be?
6. Some astronomers think Pluto is an asteroid. Do you think it is a planet or an asteroid? How do you know?
7. What are Saturn's rings made of? Where did the rings come from?

Part C: Extensions
(complete any 2 of the 7 tasks below)

1. Add the star Polaris to one of your drawings from Part A and label it.
2. Add any planet to one of your drawings from Part A and label it.
3. Find any other constellation in the sky and draw it.
4. Draw, paint or sketch a picture of what you think the surface of any planet might look like (except the Earth!).
5. Describe the day of an astronaut in space.
6. Using an actual star map, create a new constellation and write a myth to explain it.
7. Create a saying to help you remember the order of the planets in the Solar System.

Nova Level:
Master Task List

Part A: Observing*
(complete any 3 of the 7 tasks below)

1. Draw the Pleiades, open star cluster (October through March)
2. Draw any planet, as seen in the sky (varying throughout the year)
3. Draw the constellation Bootes (April through August)
4. Draw the constellation Ursa Minor/Little Dipper** (year-round)
5. Draw the Moon for 3 days in a row (year-round)
6. Draw the constellation Pegasus (August through December)
7. Draw any three constellations from the Zodiac***(counts as three tasks; year-round)

* Use the observation recording form in this package, or create one that contains the same information.
**Requires dark skies
*** Zodiac constellations are: Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpio, Sagittarius, Capricorn, Aquarius, Pisces – **these must be different than the ones drawn for the Star Level.**

Part B: Thinking
(complete any 3 of the 7 tasks below)

1. What are the Aurorae Borealis? When does your community have the best chance to see them?
2. What is a solar eclipse? What is the safest way to view one?
3. What is a light-year? How many kilometers are in a light-year? How close is the nearest star, and the nearest galaxy, in light-years?
4. How old is the Earth? The Sun? The Milky Way Galaxy? The Universe?
5. Why are major observatories built on the tops of mountains? List at least three reasons.
6. Define the term “retrograde.” Which planets move in a retrograde fashion?
7. How long does it take light to go from one end of the Milky Way Galaxy to the other? Compare this with the age of the Milky Way.

Nova Level:
Master Task List

Part C: Extensions
(complete any 3 of the 8 tasks below)

1. Find a website which will tell you when you can next see the International Space Station go by overhead. When will that be?
2. Design an 8½" by 11" poster to invite people to a local "star party."
3. What is zodiacal light? When can we see it next?
4. Draw or paint the Northern Lights, based on photos or observation.
5. USING PRECAUTIONS, observe and draw the Sun. If you are unsure how to properly observe the sun, go to http://www.cascaeducation.ca and visit the Solar Observing page. Viewing the Sun improperly can result in serious, irreversible damage to your eyes, and you can go blind.
6. Observe the Moon through binoculars and sketch what you see.
7. What is the ecliptic? What would an astronomer expect to find when looking along the ecliptic?
8. What is a sunspot? What happens to the Earth when there are fewer sunspots than usual on the Sun?

Supernova Level: Master Task List

Part A: Observing*

(complete any 3 of the 8 tasks below)

1. Draw the Moon, as seen through a telescope. (year-round)
2. Draw any planet, as seen through a telescope. (varying throughout the year)
3. Draw M42, the Orion Nebula. (November through March)
4. Draw the M31, the Andromeda Galaxy. (August through February)
5. Draw Brocchi's Cluster, a.k.a. the "Coathanger Cluster." (May through October)
6. Draw M44, the Beehive Cluster. (January through June)
7. Draw the double star Albireo. (May through October)
8. Draw the double star Mizar. (year-round)

***All of these observing targets require the use of binoculars or a telescope**. Use the observation recording form in this package, or create one that contains the same information.

Part B: Thinking

(complete any 3 of the 7 tasks below)

1. Determine the age of the Universe, and describe how astronomers figure out the age.
2. What is dark matter? How do we know if it exists if we cannot "see" it?
3. Astronomers have found over 100 planets outside our solar system, revolving around other stars. Describe one way of detecting these planets.
4. What is the Drake equation? What does it tell us?
5. Four man-made objects have now left our solar system. What are they? When were they launched? Where are they now?
6. Describe how the solar system formed.
7. What will happen to the Earth when the Sun uses all of its fuel and "dies?" When will this occur?

Supernova Level:
Master Task List

Part C: Extensions
(complete any 3 of the 8 tasks below)

1. Construct a scale model of the solar system, using common objects.
2. Create a poster showing the life cycle of a star, from birth to supernova.
3. If the Earth was no longer inhabitable, and we had the capability to leave, where should we go? Why?
4. Draw M57, the Ring Nebula, based on actual observation. (summer)
5. Draw the M7 star cluster, based on actual observation. (summer)
6. Draw galaxy pair M81 and M82. (year-round)
7. Attend the next public meeting of a local astronomy club, and write a brief summary of the events that night.
8. Draw a detailed picture of the Milky Way Galaxy. Indicate where our solar system is found within the galaxy.

Canadian Junior Astronomer Program – Star Level
Class Checklist

Student Name	Observing						Thinking							Extension						
	Big Dipper	Cassiopeia	Orion	Cygnus	Hercules	Zodiac	Observatory	Eclipse	January	Comet	Leap Year	Pluto	Rings	Polaris	Planet	Constellation	Draw	Astronaut	New Constellation	Acronym

Canadian Junior Astronomer Program – Nova Level
Class Checklist

Student Name	Observing							Thinking							Extension							
	Pleiades	Planet	Bootes	Ursa Minor	Moon	Pagasus	Zodiac	Aurorae	Eclipse	Light year	Age	Observatory	Retrograde	Milky Way	Website	Poster	Zodiacal light	Draw	Sun	Moon	Ecliptic	Sunspot

Canadian Junior Astronomer Program – Supernova Level
Class Checklist

Student Name	Observing								Thinking							Extension							
	Moon	Planet	M42	M31	Coathanger	M44	Albireo	Mizar	Universe age	Dark matter	Other planets	Drake equation	Man-made	Solar system	End of Earth	Scale model	Poster	Leaving Earth	M57	M7	M81 & M82	AstroClub	Milky Way

Recording the Night Sky: Taking Observations

In all areas of science, we are asked to describe what we see – being able to make qualitative and quantitative observations is an important part of any scientific inquiry process. This is especially true in astronomy, where even a photograph or video recording of the celestial object cannot truly capture what the observer sees and experiences.

Recording observations not only gives the student a record of what they saw, but also encourages detailed drawing skills (which can also be used when making detailed microscope diagrams, or similar situations). The student is also left with a documentation of their observing experience – something that will remind them of the time they started discovering the skies.

Provided in this package is a sample observation recording form, for use with the observing components of the Canadian Junior Astronomer Program. You do not need to use this specific form – you, as a teacher, can create another one, or have the students come up with their own design. Depending on the number of observations you want your students to record, a logbook could even be made by binding several observation recording pages together.

Regardless of the type of form used, all observing records should contain the following information: the location, date and time of the observation, the sky conditions or weather, and the instrument used to make the observations (visual/naked eye, binoculars and/or telescope), with the more details, the better. These forms also have a space to name the object observed, draw the object and list any notes about the experience (ie. "wow!" "tough to draw," "jumped right out at me!" "not as exciting as I had thought"). A sample form is filled out below.

When you are ready to observe with a group, be sure to bring along copies of star-charts (available at http://www.cascaeducation.ca), pencils with erasers, clipboards, flashlights covered with either a red filter, or a brown paper bag (better for night vision)

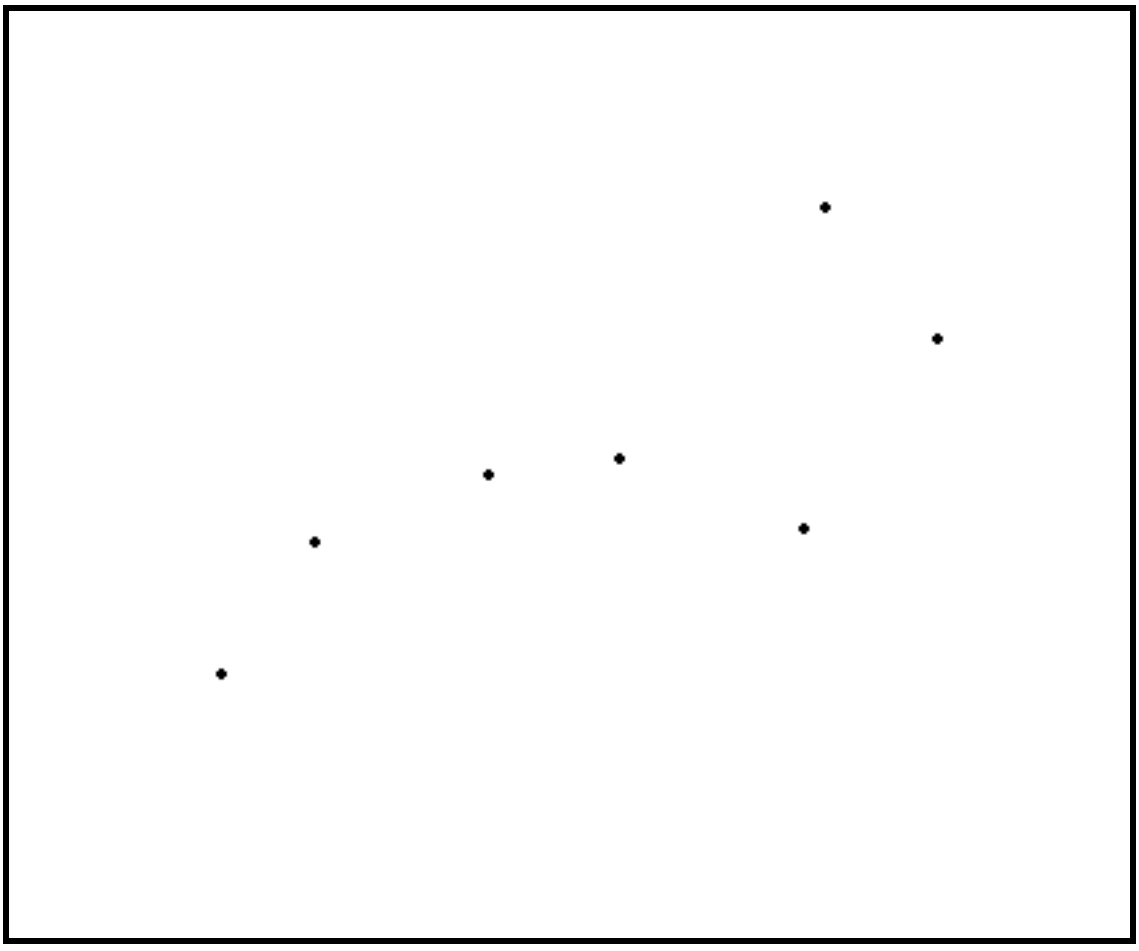
Clear Skies!

Drawing the Night Sky: Sample Observation Form

Date & Time: Friday, January 24, 7:30 – 8:30pm

Location: Schoolyard Sky Conditions: Clear, little clouds

Instrument Used: Naked Eye



Object Observed: Big Dipper

Notes: It's hard to see why they call this the bear...it looks more like a saucepan! It's very cold – hard to draw in cold weather!

Drawing the Night Sky: Observation Form

Date & Time: _____

Location: _____ Sky Conditions: _____

Instrument Used: _____

Object Observed: _____

Notes:

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Online Resources

Both students and teachers will find these electronic resources useful in completing the Canadian Junior Astronomer Program

SkyCharts/What's in the Sky?
Pocket Planetarium (updated quarterly) –
http://www.planetarium.montreal.qc.ca/Information/publications_a.html
Visibility of the Planets (updated yearly) –
http://www.cascaeducation.ca/files/planetary_data.html
Skymaps (updated monthly) –
http://www.skymaps.com/downloads.html

Weather Resources
Environment Canada –
http://weatheroffice.ec.gc.ca
Forecasts for astronomers by Environment Canada –
http://weatheroffice.ec.gc.ca/astro/clds_vis_e.html
The Weather Network –
http://www.theweathernetwork.com
Clear Sky Clocks –
http://cleardarksky.com/csk

Frequently Asked Questions
FAQ from Canadian Students –
http://www.cascaeducation.ca/files/astro_faq.html
Ask an Astronomer –
http://curious.astro.cornell.edu

Miscellaneous
The Properly-Dressed Astronomer –
http://www.cascaeducation.ca/files/images/observer.gif
More Information on Observing Logbooks –
http://www.rasc.ca/observing/page5.html
Amateur Astronomy Clubs Near You –
http://www.skynewsmagazine.com/pages/clubs.html

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Generic Rubric – Canadian Junior Astronomer Program

Name: _____ Level: _____

Categories	Level 4	Level 3	Level 2	Level 1	Not there yet	Mark
Knowledge/Understanding						
Understanding of concepts	Demonstrates thorough understanding of concepts, principles and theories; answers are detailed and thorough	Demonstrates considerable understanding of concepts, principles and theories; answers are detailed	Demonstrates some understanding of concepts, principles and theories	Demonstrates limited understanding of concepts, principles and theories;	Demonstrates little or no understanding of concepts; answers are poorly thought out	/ 15
Thinking, Inquiry, Problem Solving						
Application of the skills and strategies of scientific inquiry Researching	Applies all or almost all of the skills and strategies of scientific inquiry; research is thorough	Applies most of the skills and strategies of scientific inquiry	Applies some of the skills and strategies of scientific inquiry	Applies few of the skills and strategies of scientific inquiry;	Applies no skills or strategies of scientific inquiry; very little research attempted	/ 5

Communication						
Communicating reasoning in writing (spelling, grammar)	No spelling mistakes; grammar is flawless	No spelling mistakes; some flaws in grammar	Few spelling mistakes; many flaws in grammar	Some spelling mistakes; weak grammar	Many spelling mistakes; very poor grammar	/ 5
Communication of information and ideas: Logbook	Communicates information and ideas with a high degree of clarity and precision; logbook is neat and in excellent condition	Communicates information and ideas with considerable clarity and precision; logbook is neat	Communicates information and ideas with moderate clarity and precision	Communicates information and ideas with limited clarity and precision; logbook is messy	Communicated information and ideas with little to no clarity; logbook is messy and in poor condition	/ 15
Making Connections						
Understanding of connections among science, technology, society and the environment Extensions (Part C)	Shows thorough understanding of connections in familiar and unfamiliar contexts	Shows considerable understanding of connections in familiar and unfamiliar contexts	Shows some understanding of connections in familiar contexts	Shows limited understanding of connections in familiar contexts	Shows little or no understanding of connections in familiar contexts	/ 10

Final Mark and Comments: