Easy Star Gazing
Autumn 2013

Slide 1
Welcome to Easy Star Gazing, I'm the Street Astronomer

I'm here to help you get acquainted with the greatest and oldest show on earth, the night sky. You'll leave this presentation knowing more about what there is to see in the sky and how to see it. This presentation focuses on star gazing from your front yard and during camping trips. None of this presentation requires a telescope or a degree in astrophysics; it just requires your eyes and perhaps a pair of binoculars and a digital camera.

Slide 2
Here's a list of tonight's topics. Some of this will go fast, but the topics are fun and they'll add astronomical fun to your evenings. Our first astronomical observation begins just after the sun sets.

Slide 3
We'll start with an astronomical phenomenon that most people over look, the earth's shadow.

Slide 4
Since we stand on a curved earth, we can peer down the other side of the earth. As a result, we can see a projection of the earth's shadow on the atmosphere. Not only that, but we also see the projection of the dusk's light on the atmosphere. How does this look?

Slide 5
I took this picture of the earth's shadow about seven minutes after sunset. You can see the dark band of the earth's shadow below the red glow of sunset. This picture hardly does justice, as I was also able to see a bit of yellow in the red. Many of you may have seen this but didn't realize. To see the earth's shadow, look opposite the sunrise or sunset. For 15 or more minutes before sunrise or after sunset, you'll see the uniformly darker earth shadow rise or fall. A simple camera and short exposure was all I needed to record this image on film.

Slide 6
To get around the sky, you need a road map. This part of our presentation will give you that map. This map involves just a few widely spaced constellations, so it's easy to learn and covers a large portion of the sky.

Slide 7
First the constellations almost everyone knows; Ursa Major. Most people only know the Big Dipper and not the Big Bear. You can see how the dipper is actually only a small part of the bear. In the dipper, or bear, there are two stars called The Pointers. The Pointers form a line that leads almost directly to Polaris, or the Pole Star at the end of the tail of Ursa Minor. Polaris has the distinction of being very close to the North Pole in the sky.

To our eyes, it appears every star revolves around the Pole Star and that it is stationary. If you lose your directions at night, then use Polaris to locate north. Polaris is the 40th brightest star in the sky and 430 light years away. The light of Polaris you see tonight began its journey to your eyes back in the year 1579.

Slide 8
Looking high in the west in September and lower as we approach winter, is a triangle of bright stars. The stars are not one constellation, but the lucida of three constellations. The brightest of the three is Vega, the alpha star of Lyra the lyre. A lyre is a classical Greek musical instrument that is similar to a harp. The next brightest is Altair. That's the star in the movie, Forbidden Planet. The faintest, but most distant star is Deneb. Astronomers call Deneb Alpha Cygni.

Relative to other bright stars, Vega is not really all that bright. The reason Vega appears so bright is because it's only 25 light years away. So if you were born in 1984, Vega is your birthday star this year.

Altair is the 12^{th} brightest star in the sky and only 17 light years away. So it you were born in 1992, Altair is your birthday star this year.

Deneb is between 1600 and 2600 light years away. It's one of the largest and brightest stars in the Milky Way galaxy. If Deneb were to replace our Sun, Deneb would fill the orbit of Earth. Within a few million years, Deneb will end its life in a supernova explosion.

Slide 9
High in the south and nearly overhead in September is a square pattern of stars called the Great Square. The Great Square is the front body of Pegasus the flying horse. Pegasus is upside down. His neck and head are the curve of stars in the lower right. His front feet are curled up.

Connected to Pegasus at his belly button is the head of Andromeda by the star Alpheratz. Andromeda was the daughter of Queen Cassiopeia and King Cepheus. In Greek mythology, Andromeda was chained to the rocks on the shore of Ethiopia as a sacrifice to a sea monster that was terrorizing the land. Before the sea monster could devour her, however, the hero Perseus flew in on winged sandals and rescued her.

Slide 10
Low in the northeast you'll find the bright "W" of Cassiopeia and Perseus.

Slide 11
Late at night in September, Taurus the bull rises in the east. Its lucida is the orange star Aldebaran and represents the eye of the bull. The light you see from Aldebaran left the star 65 years ago. If you were born in 1944, Aldebaran is your birthday star. Aldebaran represents the eye of Taurus the bull. Surrounding Aldebaran is the star cluster of the

Hyades. Aldebaran is not part of the Hyades, it just happens to lie in front of the cluster. At the shoulder of the bull is a star cluster named the Pleiades or Seven Sisters.

Slide 12
Here's a comparison between the sun and Aldebaran. The star Betelgeuse is in Orion and will rise later in the year. Antares is the heart of Scorpius and it recently set. Notice that at this scale, the sun is a single pixel in this image and the earth is 110 times smaller.

Slide 13
Interplanetary dust and all five classical planets are prominent at some time this autumn.

Slide 14
On the days when the moon is between new and full and an hour or more before sunrise, look for what looks like the glow of twilight in the east. Except this glow doesn't hug the horizon, it will stand up like a leaning pillar of light. That light is sunlight reflecting off dust in orbit around the sun. Astronomers call this glow the Zodiacal Light and its dust comes from the dust of comet tails. Our solar system is in need of a good dusting. The best times to see the Zodiacal Light this year are September 3 – 17 and October 3 – 17.

Slide 15
Mercury is visible late November. Before then, it remains too close to the sun to see very well. Look for it starting the second week of November in the low east-southeast. Don't confuse it with the star Spica.

Slide 16
Venus appears as the Evening Star this autumn. Venus is the brightest star in the west and visible before it gets dark. The planet is slowly approaching the sun and doesn't change its elevation above the horizon very much until December. A pair of binoculars may show its crescent shape the first week in December. Look before the sky gets dark, as Venus can be so dazzling that you can't make out is shape if the contrast between Venus and the sky is too great.

Slide 17
Mars is ahead of Earth in its orbit around the sun. It won't be until next year that we catch up. Therefore, Mars remains a morning planet. Mars cross the constellation of Leo the Lion in October and will get very close to its brightest star, Regulus in the moiddle of the month.

Slide 18
Jupiter is a very bright morning planet. It rises after midnight in early autumn but will rise well before midnight this winter. Jupiter, the largest planet in the solar system, is opposite the sun from Earth's perspective. Jupiter's four largest satellites are visible with modest optical aid. This includes your binoculars and cameras with zoom lens.

Slide 19
Saturn is an evening object. However, it is approaching the sun this autumn and will disappear by the end of September. We won't see it again until November when it will appear in the morning sky.

Slide 20
The easiest astronomical body to observe is the moon. So let's discuss aspects of the moon that you'll see while camping.

Slide 21
First, the moon has phases. Here are the names of the phases and the moons typical age during that phase.

When the moon grows in size, it is waxing. When it gets smaller, it's waning. When the moon is less than half full, it's a crescent. When it's greater than half full, it's gibbous.

The moon phase begins at new moon. The moon is a waxing crescent until first quarter, or half full. Then the moon becomes a waxing gibbous until it's full. From new moon to full moon takes just over 14 days and the moon rises before sunset. After full moon, the moon begins waning. Therefore, it's a waxing gibbous until it's half full at third quarter. It continues to shrink and is a waning crescent. At 29 days, the moon reaches new again and cannot be seen.

Slide 22
Ever look at the thin crescent moon and see what looks like the rest of the moon? It is the dark side of the moon and it's illuminated with earth light. Sunlight reflecting off the earth casts just enough light on the portion of the moon still in the night so we can see it. The light is called Earthshine and people have often called it the old moon in the arms of the young moon. If you were an astronaut standing on the moon, you would see an earth four times larger than the moon shining in very bright blue and white light.

Slide 23
Which moon phase is the best? Well, that depends on what you're looking for.

If you want to take photographs by moonlight, then a moon from half full to full is pretty good.
If you want to see moon craters through your binoculars, then a first or last quarter moon is ideal.
If you want to scan the Milky Way with your binoculars, then a new moon or waxing crescent is best.

Slide 24
There's a lot you can see on the moon with binoculars. So let's learn the names of a few features that you can see on the moon.

Slide 25
The moon is made up of two types of terrain, maria and highlands.

The highlands are a rocky scum that was created when the moon first formed. The highlands are made of a white mineral called feldspar. It has a low density compared to the rest of the moon, so it floated to the top. Highlands are the oldest parts of the moon. We can tell this because they are heavily cratered. The highlands formed while the solar system was still forming by the collision of planet building blocks, called planetesimals.

Maria are lava flood plains. They were created when fissures erupted lava on the moon and filled the large impact basins. The lunar lava is basalt, the lava rock we see in some much of Idaho. The lava erupted on the moon after most of the impacts. So maria are devoid of the large, shoulder to shoulder craters you see in the older highlands. Maria is plural for mare and mare comes from the Latin word for sea.
Here are two rocks from Idaho that are similar to what astronauts find on the highlands and maria.

PASS AROUND THE MOON ROCK ANALOGS

These are the names of a few of the maria visible on the moon. Please mark your Lunar Maria sheet like this slide. Afterwards, we'll give you a quiz.

These mare are called
Sea of Serenity
Lake of Dreams
Sea of Tranquility
Sea of Crises
Sea of Fertility
Sea of Nectar
Sea of Vapors
Central Bay
Sea of Clouds
Sea of Moisture
Seething Bay
Ocean of Storms
Sea of Rains
Bay of Rainbows
Sea of Cold

Slide 26
Now call out the name of the mare in the next three quiz questions. Don't worry if you get them wrong, we're not giving a grade. Oh, you can also use your notes. Ready?

Slide 27
This mare is named?
(Sea of Rains)

Slide 28
This mare is named?
(Sea of Serenity)

Slide 29
This mare is named?
(Ocean of Storms)

Slide 30
Now that you know a few lunar seas, let's try a few prominent craters. Young craters have ejecta blankets and rays. Tycho is a great example of this. The craters Plato and Grimaldi are old craters and flooded with lava. Please mark your Lunar Craters sheet like this slide. Afterwards, we'll give you a quiz.

Slide 31
These three large craters are more prominent at first or last quarter.

Slide 32
Now call out the name of the crater in the next three quiz questions. Don't worry if you get them wrong, we're not giving a grade. Oh, you can also use your notes. Ready?

Slide 33
This crater is named?
(Tycho)

Slide 34
This crater is named?
(Grimaldi)

Slide 35
This crater is named?
(Copernicus)

Slide 36
Probably everyone has heard of the man on the moon. But how many have seen him or even the rabbit on the moon? Here's how the mare on the moon create the images of a young woman, older man, and a rabbit.

As the moon traverses the sky, it appears to rotate. That occurs because the moon keeps its poles pointing in the same direction with respect to the solar system. The moon's rotation emphasizes different aspects of the mare.

Slide 37
As the moon rises, its North Pole tilts towards the left. This can make the mare appear as a woman who is dancing or reading or reading a book.

Slide 38
A little later, the moon's North Pole points more towards the top. The rotation gives the mare the appearance of the Man on the Moon.

Slide 39
Closer to moon set, the lunar North Pole appears to point towards the upper right. The moon's apparent rotation is great enough that we make out a rabbit shape on the moon. In Japan, this rabbit is the Shogun of the Moon.

Slide 40
There are no lunar eclipses for use to observe this autumn. However, the moon makes a great guide to the night skies. You all should have an autumn lunar guide. If you can take a quick look at it, you'll see that it lists the days of the moon's phases and when it passes near an object of interest in the sky.

Slide 41
Along with planets and stars, you'll see meteors while you star gaze. So let's take a minute to discuss them.

Slide 42
Most meteors you see are bits of comet dust. When a comet enters the inner solar system, it forms a tail of dust and gas. The dust follows the comet in its orbit around the sun. When the earth passes through the orbit of a comet, dust ejected from its tail years or centuries ago will slam into the atmosphere. The dust and sand grains can have speeds approaching 70 miles per second. We call this tiny particle a meteoroid.

Slide 43
When meteoroids enter the atmosphere that fast, they create a shockwave that compresses the air ahead of it. The shocked air gets very hot; so hot that its heat will warm and melt the grain. The meteoroid creates a channel of hot glowing air and appears as a luminous streak in the night sky. That streak is called a meteor, or falling star. Most meteors you see are 60 to 80 miles above the ground and will melt and vaporize long before they can reach the ground. Sometimes the air is left glowing like the gas inside a fluorescent light. When this happens, a faint trail is left hanging in the sky. The trail can persist for several seconds to more than several minutes. A meteor flashes across the sky in just a few seconds.

PRETEND TO BE LOOKING FOR METEORS

So normally when some one says…..

POINTING TO WHERE NO ONE ELSE IS LOOKING

Oh, there's a good one!

TURN TO LOOK

……it's usually over before anyone can see it.

Occasionally though, you'll see a slow one that takes 5 seconds to travel. Larger and faster meteoroids create the brightest meteors. Some times they can be as bright as the moon. Really bright ones are called bolides and they can end in a terminal burst of light. The burst of light can be followed by fainter colored sparks.

PASS AROUND METEORITE

If a meteoroid is large, several inches or larger across, they can survive their passage through the atmosphere and land on earth. A meteoroid that makes it to the ground is called a meteorite.

Here are two examples of meteorites. The first is a nickel-iron meteorite. It was originally the core of a newly forming planet when a collision with another forming planet shattered it to bits and pieces. The second is a stony meteorite and it use to be the crust of a forming planet or an old asteroid. A collision chipped off pieces of the outer crust that eventually made it to earth.

Slide 44
Because comets follow the same orbit around the sun, earth will run into their dusty orbits the same time each year. When this happens, we see an increase in the number of meteors per hour. This is a meteor shower. Meteors from the same shower enter the atmosphere in the same location. This makes them appear to radiate from one point in the sky. Perspective makes them appear to fan out like this slide shows. If you trace the meteors back, you'll find they appear to originate from one point in the sky.

Typically on any given night there are seven meteors per hour. During a meteor shower the number can go up to over 60 meters per hour, or one per minute.

The three showers this autumn are the Orionids, Leonids, and Geminids and they are listed in your meteor shower handout.

Slide 45
There are three good meteor showers this autumn, however each occurs when the moon is at or near full. The full moon's impact will diminish these showers, so you'll probably want to observe them a week or so before their peak.

Slide 46
Along with meteors, you also see satellites drifting across the sky. Satellites look different than meteors or airplanes. Meteors are swift and can change in brightness very fast. Airplanes blink and show color. Satellites on the other hand drift slowly across the sky and tend to not change brightness, or at least not very fast.

Slide 47
Satellites are visible when the sky is dark but the sun is not far below the horizon. When the sun is not far below the horizon, its light will still illuminate the satellite. We see that reflected sunlight in a dark sky. In dark skies, you can expect to see at least half a dozen satellites. They will appear as stars slowly drifting across the sky. A satellite can take as long as fifteen minutes to travel from one horizon to another. Often the satellite will fade out before reaching the horizon. That's because the satellite has traveled out of the sun's light and into the earth's shadow. Some satellites slowly pulsate in brightness. These satellites are usually rocket boosters left in earth orbit. As the long cylindrical booster tumbles end for end, its size and therefore brightness appears to fluctuate. Satellites will not blink, nor will they have lights right next to them. Those are airplanes.

The most enjoyable satellites to look for are the ISS and Iridium satellites.

Slide 48
To find when ISS will be visible or an Iridium satellite will flare, go the Heavens Above website, www.heavens-above.com. Then under configuration, select the option to pick a location from their database.

Slide 49
In the Name field, type your city. As long as it's not a tiny little town, Heavens Above will have one or more entries for the town's name. Select your town and state. Then save the website under your favorites so you can select it anytime you want to know what satellites are visible. Alternately, go to my website, NearSys.com and look under Easy Star Gazing – you'll find the direct link there.

Slide 50
Now that you're looking at the right page, select either, ISS passes for the next ten days or Iridium flares for the next seven days for the town closest to where you live. Be sure to save this webpage in your list of favorites.

Slide 51
The report will look like this. In your packet, you have the same reports for Topeka/Lawrence.

BRIEFLY DESCRIBE WHAT'S ON THE LISTING, POINT OUT IF SOMETHING BRIGHT IS HAPPENING TONIGHT

Slide 52
How many people have tried using binoculars at night? Did you know binoculars are a great astronomical tool? They're easy to point and you can use both eyes. Briefly, let's describe binoculars and what you can see with them. Please follow along with your binocular maps, and other handout you received tonight.

Slide 53
First, you'll notice there's two popular numbers associated with binoculars. For example, 7 by 50. The first number is the magnification of the binoculars. The larger this number, the larger objects appear magnified in your binoculars. You really don't need high magnification in your binoculars. A magnification of 7 or 10 is plenty. Too much magnification usually means the binoculars are larger and heavier. That means they're harder to hold steady. You won't see nearly as much detail in binoculars if they shake in your hands.

The second number is the diameter of the objective lens in millimeters. 50 millimeter lens are two inches in diameter. The larger the diameter, the more light they gather and the brighter objects appear. But also the larger the objective, the heavier the binoculars and the more difficult it is to hold them steady.

A pair of 7 by 50 or 10 by 50 binoculars is perfect for astronomy.

HOLD UP A PAIR OF BINOCULARS

Here are two important things to check on binoculars before buying them.

Alignment: First check that they are properly aligned. If the binoculars aren't aligned, the images in your eyes aren't aligned either. That means you'll see double images rather than a single object.

Focusing: Check that the binoculars focus properly when you aren't wearing glasses. Most binoculars focus with a ring in their center. Take off your glasses and try focusing a binocular at something on the horizon. If you can't twist the focuser enough to remove the blurriness of the horizon, then look for a different pair of binoculars.

HOLD UP MASSIVE BINOCULARS AND SHAKE

Binoculars views are best when the binoculars are held steady. So try propping them on stationary objects like a tree. Alternatively, you can now purchase a pair of image stabilized binoculars. These binoculars use a prism that bends the path of light. The prisms moves around to compensate for the movement of your hands.

Slide 54
Here's a list of easy to find objects to look at in binoculars this autumn.

Slide 55
Mizar and Alcor were the first double star discovered. Good eyes can split them ins dark skies and binoculars show them better. However, binoculars won't show you that Mizar, the brighter star is double, but a lower power telescope can. So binoculars show Mizar and its companion star, Alcor while a simple telescope will show three stars total.

Slide 56
The Milky Way is the edge of our galaxy as seen from inside it. The Milky Way rises from between Sagittarius and Scorpius and passes overhead in autumn. Sweep the Milky Way with your binoculars to see the hazy Milky Way turn into clouds of stars.

Slide 57
The brightest star in Perseus is part of an association, or small group of stars. There are too few stars in it for astronomers to call it a cluster, so instead they call it an association. The Alpha Persii association formed from the same cloud of dust and gas. In time, the stars will drift a part, since their mutual gravity isn't strong enough to hold them together.

Find Perseus and then its brightest star, Mirfak. Keep your eye on it as you raise your binoculars to your eyes. You'll see a sprinkle of stars surrounding Mirfak.

Slide 58
A galaxy of over 100 billion stars is easily seen in your binoculars. Andromeda is the thin curving V coming from Pegasus. The bottom row of stars is most easily seen. The second star in the row is the brightest, so aim your binoculars there. Look up to the next star; you can't miss it in your binoculars. With those two stars in sight, go the same distance up once more. There's a star you'll see with a large fuzzy cloud next to it. That's Andromeda Galaxy. The galaxy is bright in the center and noticeably longer than it is wide. In dark skies it will stretch nearly across your binocular's field of view.

Slide 59
You'll have to wait until after midnight to see the Hyades and Pleiades. Or if you wait to a cold November night, you can see them before 10:00. Both are easy to find with just your eye. Look straight at them and then lift your binoculars to your eyes. The Pleiades cover a smaller area than the Hyades. The Hyades will fill the binoculars with a couple dozen stars. The Pleiades look a lot like a little dipper.

Slide 60
Jupiter is dazzling bright in binoculars. Still, you can see up to four of its largest satellites, the Galilean Satellites. Galileo discovered them in the winter of 1609 and 1610. These moons of Jupiter are roughly the size of earth's moon and appear as stars forming a line through Jupiter. Check on them night after night to watch them shift sides and positions around Jupiter.

Slide 61
Cameras are small enough that they can be carried in a back pack. You can find equally small tripods also. So let's talk about using your camera to take astronomical photographs while camping.

POINT OUT CAMERA ON TRIPOD

To take astronomical photographs you'll need a camera with bulb setting. This lets the camera shutter remain open for as long as you wish.

Then you need a tripod to hold the camera steady. Exposures at night are from several seconds to several minutes or even hours long. Without a tripod you'll have to rely on propping your camera up against a stationary object like a rock. Here are two examples of tripods. Both are light weight, but one is a lot smaller than the other.

HOLD UP MINI TRIPOD

Then you need a cable release. The cable release does two things. First it lets you open the camera shutter without jiggling the camera. It also lets you lock the camera shutter open.

Here are some examples of what you need to photograph at night.

Be sure your camera lens is focused for infinity. If it's not, the stars become fuzzy circles in your pictures.

Here are some examples of what you can record.

PASS AROUND FRAMED PICTURES

Star Trails: If you leave the camera pointed at the sky and the lens opened for several minutes to several hours, you'll record the paths of stars as they travel across the sky. Typically you want to place an interesting landscape in the foreground. If you want the trails long, you need to leave the shutter open a long time. During long exposures the film becomes less sensitive to light and it can overexpose and fog. One way to get around this is to increase your lens' f-ratio. Instead of leaving the lens wide open, you can slow it down to f-8.

At the end of your star trail photograph you may want to flash the foreground. Since the flash is so brief, the sky above the terrain remains dark. Flashing brings out foreground features while retaining the already recorded star trails.

Aurora: Auroras are pretty bright, so an exposure of 15 seconds can plenty long enough. For an aurora photograph, leave the lens wide open.

Satellites: If you know when a bright satellite, like ISS or an Iridium flare will occur, you can position the camera in advance and let the satellite drift through. Since this normally takes less than 10 minutes, you can leave the camera lens wide open.

Meteor Showers: Recording meteors usually takes a lot of film unless you're lucky or there is a significant meteor storm. To record the faintest meteors, leave the lens wide open and keep the exposures less than an hour. The darker the sky, the longer the exposure can be.

Landscapes: Just because the moon is out doesn't mean you can't photograph at night. Moonlight adds an ethereal feel to a landscape. So set your camera up and leave the shutter open for several minutes.

Here are some things you can recode with a simple digital camera.

Slide 62
A digital camera with optical zoom will let you record images of the four largest satellites of Jupiter. I took this one with a zoom of six power and an exposure of two seconds. I just had to set the camera on a tripod and pressed the shutter switch.

Slide 63
The most famous star cluster is the Pleiades or Seven Sisters. Many people confuse it for the Little Dipper because of its shape. I took this picture with an exposure of a few seconds long.

Slide 64
Another famous star cluster is the Hyades. It forms the head and eye of Taurus the Bull and it's not very far from the Pleiades. This picture was taken in Topeka, Kansas with an exposure of a few seconds long.

Slide 65
This movie was created by taking pictures of the Big and Little Dipper every 15 seconds. I then imported the images into Microsoft Movie Maker and turned then into an animation showing the effect of Earth's rotation.

Slide 66
There's more detail on your resources hand out.

First, check out the local astronomy club's website. The Boise Astronomical Society meets at DCI on the second Friday of every month. The club also hosts monthly star parties for the public, including one at Bogus Basin this June.

The College of Idaho in Caldwell has a planetarium that presents monthly shows.

The largest observatory opened to the public is at Bruneau Dunes Sate Park. The observatory is opened from April to October and there is a astronomy presentation prior to the observatory opening.

The largest planetarium is located at the Herrett center on the campus of CSI. On top of the center is another large telescope opened to the public.

Idaho skies is a radio show on Radio Boise, 89.9 FM. Along with the show is a Twitter account and blog.

Monthly star maps are available at Starmaps.com. Over the course of a year you can learn your way around the night sky with their map downloads.

Slide 67
A planisphere is an adjustable version of the star map and they're available from some book stores, museums, camping stores, and online. Here's how you use one.

DEMONSTRATE SETTING UP A PLANISPHERE FOR TONIGHT