Click on the button for the level you need:

- **Brownies**
- **Juniors**
- **Cadettes**
- **Seniors and Ambassadors**
Outdoor Skills Patch
Navigation – Brownies

Learn the skills needed to thrive in an outdoor environment. Do you know how to use different navigation techniques? Do you want to learn to find your way on a trail?

PLEASE NOTE:
• Compasses are available at the Salt Lake City Shop for rental.

Step 1:
Learn about trail maps

Materials Needed:
- Trail Map (See Arches National Park in the resource section as an option) – 1 per person
- Compass – 1 per person
- A small piece of string for each girl (about 6 inches – used to help measure distance)
- Paper
- Markers

Lesson Plan:
1. Gather the girls and explain that “Today we are going to start learning about how to navigate while outdoors. What do you think navigate means?”
   a. The act, activity or process of finding the way to get to a place when you are traveling.
   b. “Awesome job! It is a way to help us not get lost while we are exploring the outdoors and navigation helps us find where we’re going! We are going to begin with learning how to read maps.”

2. Hand out a compass and a map to each girl or small groups of girls. You can either use the trail map of Arches National Park (see resource section) or find a trail map of somewhere nearby your troop’s location.
   a. Make sure your map includes: at least one trail, a key/legend, an orientation arrow (North arrow), and a scale.

3. Have a discussion with the girls and see if they can name the different parts of the map. Try to make this a girl led discussion with them pointing out the different parts and you assisting by filling in the gaps:
   a. **Orientation Arrow** – This is used to help us orient or position our map correctly.
      i. Have the girls use a compass at this point to find North.
      ii. In order to find North, the girls will lay the compass flat and rotate the entire compass until the red part of the needle is located inside the red arrow on the baseplate.
      iii. Girls will learn more about the compasses in Step 3. Just focus on finding North for now.
iv. Have the girls find the NORTH direction on their map (known as the **orientation arrow**). Then have them lay their map down so the map’s North is pointing in the same direction as their compass arrow.
v. Ask the girls why it’s important that our map points North. (So we can find things easier because they’ll be in the same location as on the map.)

b. **Legend/Key** - This is used to identify the different things on the map including different types of trails, roads, and points of interest.

c. **Hiking Trail** – where you can go to hike and the general direction the trail will go

d. **Point of Interest** – a place where it is suggested you go and see

e. **Scale** – how you tell how far one thing is to another and how long a trail is.

   i. Try it out – using a piece of string, follow one of the trails on the map, make sure to copy all the turns and bends in your piece of string as well. Then keeping the start and end points held on the string, measure it on the scale. About how many miles is the trail you measured?

4. What else can the girls identify on the map?

5. Now that the girls have learned how to read a trail map, have them create their own trail map!

   a. Have the girls pick a location they know well or the location you’re currently at (ex: the route they take to school, or how they walk to the closest park, or a map of the park, or maybe you can draw a map of the camp/park/forest you’re currently at!)

   b. Have the girls draw a trail map of their chosen location!

      i. Have them try and keep scale in mind (it doesn’t have to be perfect)

      ii. Talk about the colors on a map and what they represent (ex: blue typically represents water, green often indicates forests, black is typically roads)

      iii. Things to include: at least one trail (or the route that they take on the roads) – include more if you know them, points of interest on the trail or nearby, a key/legend, an approximate scale marker, an orientation arrow (work with the girls on how to best guess which way is North.

6. Once the girls have completed their maps have them share their maps with another girl in the troop or with an adult. Have them talk about the different parts of their map and where the trail goes!
Step 2:
Learn how to follow trail signs

Materials Needed:
- Hiking Trail
- Rocks/sticks found from the ground
- Trail Signs Handout (see resources)

Lesson Plan:
1. Gather the girls and explain “Now we are going to learn a different style of navigation. Sometimes when you’re out hiking, your map isn’t detailed enough to get you exactly where you need to go. So in addition to maps, when the trail isn’t super clear there will sometimes be trail signs to help you find your way. Some trail signs are more permanent – they are markings on trees either carved out or painted on, there are signs on posts that are stuck in the ground, or a variety of other options. But these trail markings are clearly man-made and can sometimes take away from the experience if people want to go outdoors to escape from the business of other people."

2. “Instead, trail signs that blend more into the environment have become popular in many places so they don’t take away from the natural surroundings as much. These signs typically use rocks or sticks that have been collected from nearby areas to help people find their way.”

3. Have the girls collect rocks and sticks. Make sure the sticks are dead and downed and not broken off from trees. Try to find rocks that are sitting on the surface of the ground and not buried into the dirt. This is to have less of an impact on the land.

4. Practice making the different trail signs (see resource section). You can also refer to the Hiker badge for more trail signs to practice.

5. Once the girls have practiced making their different signs, ask them “Can you think of some locations that you would find these signs when you are hiking trails?”
   a. The desert while hiking on slick rock, on sandy trails, in fields or through meadows.

6. Have the girls practice using their trail signs by following a trail and making the sign that follows the pre-established trail to begin with. When the trail turns left, add your trail marker. If the trail continues straight for a long period, would it be nice to have a sign to tell you to keep going? Make sure to not make your trail signs too big or it will distract from the experience.
   a. After you practice, make sure to take down your trail signs to not affect the next group to hike through on your trail. It’s always important to Leave No Trace.

7. After you’ve practiced by following a pre-established trail, it’s now time to take your skills and make your own trail!
   a. Split your group into at least 2 different groups – more depending on the size of your group.
   b. Using at least 15 trail signs, set-up a course for your Brownie friends to follow. Make sure to not destroy parts of the environment while creating your trail.
   c. Challenge the other group to make it through your course. What will your trail end with? A cool view, a hug to a tree, or a surprise?
Step 3: Learn how to use a compass

Materials Needed:
- Compasses (1 per girl)
- Optional: Large compass for easier viewing

Lesson Plan:
1. Gather the girls and explain “Today we are going to learn about one of the most important tools when navigating in the backcountry – the compass.”

2. “First, we are going to learn about the different parts of the compass”
   a. Hand out a compass to each of the girls.
   b. It may be helpful to have a large compass drawn on a piece of paper to help show the different parts to a larger group.

The parts of a compass:

i. **Base Plate**: the flat base of the compass.

ii. **Dial**: the circle you turn to change the degree of travel

iii. **Housing**: the inside of the dial where the needle is “housed”

iv. **Needle**: the spinning part of the compass. The red half is magnetized to always point north.

v. **Orienting arrow**: the inner arrow printed on the bottom of the dial. This arrow helps you orient your direction.

vi. **Index pointer**: the line on the outer part of the housing that you line the degree of travel up with.

vii. **Direction of travel arrow**: once you line the degree of travel up, the direction that you will walk.

3. How does a compass work?
   a. The earth has a magnetic pull coming from North Pole. The red part of the compass needle is magnetized to always point towards the North Pole. Using the pull of the earth, we use compasses to determine all directions.
b. Because a compass works by using magnetization, it is important that you keep it away from large metal objects including: cars, flagpoles, and school desks – or you won’t have an accurate reading.

4. “Now that we know the different parts of a compass, we can learn how to use it!”
   a. How to hold a compass: Hold your compass horizontal to the ground at about belly button level. Hold it so the direction of travel arrow is pointing away you’re your belly button. Keep the compass away from large metal objects.
   b. Begin by finding North. Line the 0°/360°/N line up with the index pointer by spinning the dial.
   c. Turn your body until the compass shows the red part of the needle in line with the orientation arrow on the bottom of the plate. This is often referred to as putting Red Fred in the Shed. (Fred is the arrow and the shed is the orienting arrow.)
   d. The direction of travel arrow should then point North as well and tell you the direction to go.
   e. Have the girls point in the direction that the direction of travel arrow is pointing.
   f. If a girl is not pointing the correct direction, work with her individually to figure it out.
   g. You can repeat this section for South, East, and West to give the girls more practice and familiarity with the parts of the compass.

5. “Now we are going to try finding another direction!”
   a. Have a girl pick a number between 0 and 360. For this example we’ll use 200°.
   b. Begin by lining the 200° mark up with the index pointer by spinning the dial. This is called taking a bearing.
   c. Turn the compass until Red Fred is in his Shed.
   d. Once all the girls have Red Fred in his Shed, have them point in the direction that the direction of travel arrow is pointing.
   e. If a girl is not pointing the correct direction, work with her individually to figure it out.

6. Keep practicing until all girls are pointing in the correct direction.

7. Now it’s time to put your compass skills to the test!
   a. Have the girls spread out and have each girl place a distinct marker on the ground in front of them (this could be a rock, water bottle, backpack, etc.) Give them the following directions:
      i. Take a bearing of 60° and walk 10 steps. Stop.
      ii. Take a bearing of 180° and walk 10 steps. Stop.
      iii. Take a bearing of 300° and walk 10 steps. Stop.
   b. Each girl should have arrived back at their marker or at least very close as they have just made a triangle shape with their bearings.

8. Congratulate the girls on all learning how to use a compass! They are all one step closer to being able to navigate through an outdoor space!

**Resources:**
Trail Map for Arches National Park
Trail Signs
CAUTION
Stay on trails orsidewalks to protect fragile cryptobiotic soil crust. These tiny organisms are critical to all life in the desert.
# Trail Signs

<table>
<thead>
<tr>
<th></th>
<th>straight ahead</th>
<th>turn right</th>
<th>turn left</th>
<th>do not go this way</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rocks</strong></td>
<td><img src="image" alt="Rocks" /></td>
<td><img src="image" alt="Rocks" /></td>
<td><img src="image" alt="Rocks" /></td>
<td><img src="image" alt="Rocks" /></td>
</tr>
<tr>
<td><strong>Pebbles</strong></td>
<td><img src="image" alt="Pebbles" /></td>
<td><img src="image" alt="Pebbles" /></td>
<td><img src="image" alt="Pebbles" /></td>
<td><img src="image" alt="Pebbles" /></td>
</tr>
<tr>
<td><strong>Sticks</strong></td>
<td><img src="image" alt="Sticks" /></td>
<td><img src="image" alt="Sticks" /></td>
<td><img src="image" alt="Sticks" /></td>
<td><img src="image" alt="Sticks" /></td>
</tr>
<tr>
<td><strong>Long Grass</strong></td>
<td><img src="image" alt="Long Grass" /></td>
<td><img src="image" alt="Long Grass" /></td>
<td><img src="image" alt="Long Grass" /></td>
<td><img src="image" alt="Long Grass" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of paces in direction indicated</th>
<th>I have gone home.</th>
</tr>
</thead>
</table>

Outdoor Skills Patch
Navigation – Juniors

Learn the skills needed to thrive in an outdoor environment. Do you know how to use different navigation techniques? Do you want to learn how GPS units work?

PLEASE NOTE:
• Compasses and GPS units are available at the Salt Lake City Shop for rental.

Step 1: Create an orienteering course

Materials Needed:
- Compasses (1 per girl)
- Paper
- Pens/markers
- String to tie signs to different objects
- Writing surface (optional)

Lesson Plan:
1. Begin by reviewing how to use a compass (see Brownie Navigation for assistance if needed).
   a. How to hold a compass: Hold your compass horizontal to the ground at about belly button level. Keep the compass away from large metal objects.
   b. Begin by finding North. Line the 0°/360°/N line up with the index pointer by spinning the dial.
   c. Turn the compass until the red part of the needle is in line with the orientation arrow on the bottom of the plate. *(Putting Red Fred in the Shed)*
   d. The direction of travel arrow should then point North as well and tell you the direction to go.
   e. Have the girls walk 10 steps in the direction that the direction of travel arrow is pointing.
   f. If a girl is not walking in the correct direction, work with her individually to figure it out.
   g. Next, have a girl pick a number between 0 and 360. For this example we’ll use 200°.
   h. Begin by lining the 200° mark up with the index pointer by spinning the dial. This is called taking a bearing.
   i. Turn the compass until Red Fred is in the Shed.
   j. Once all the girls have Red Fred in his Shed, have them take 10 steps in the direction that the direction of travel arrow is pointing.
   k. If a girl is not walking the correct direction, work with her individually to figure it out.

2. Explain to the girls: “Now we are going to create our own orienteering courses using our compass skills!”
a. Split the girls up into small groups (3-4 girls per group).
   i. As a group, they will work together to create an orienteering course for other girls to follow.
   ii. Note: It may be useful to color coded markers or different colored paper with one color per group so girls can follow the correct course more easily.

b. How to set-up a course:
   i. Find a starting object (it can be a tree, light post, cabin post, etc.).
   ii. Stand directly in front of the object.
   iii. While standing there, look for a new object to walk towards.
   iv. Hold your compass with the direction of travel arrow pointing directly at the new object.
   v. Spin the dial on the compass until Red Fred is in the Shed. Note: It is important that the girls continue to point the direction of travel arrow at the object and just turn the dial. Girls may try to spin the entire compass to match the red arrows causing their bearing to be wrong.
   vi. The number in line with the index pointer will be your bearing. Write this degree on your sign.
   vii. Next have a girl count how many steps it takes to get to the new object while walking in a straight line. Have the girl go back to the starting object and tell her buddies how many steps it was to the new object.
   viii. Write the number of steps on the sign with the bearing. Signs should be smaller (index card size) so they aren’t easily seen from the starting point. This way the girls have to use the compass to know which direction to go. Signs should look similar to this:

   ![160° 34 steps]

   ix. Have the girls hang their sign on their starting point and go to the next object and start the process over again.
   x. Each course should have at least 5 stops.
   xi.

3. When all the groups have finished setting up their courses, have the girls meet back together. Have the girls stay with their groups and try to follow another group’s course.
   a. Inform girls that steps will be approximate since everyone’s steps are different.
   b. Have the group who created the course tell the groups following it what their starting point is and what color they wrote their signs in.
   c. How to follow the course:
      i. Have the group stand directly in front of the sign.
      ii. Spin the dial until the bearing is in line with the index pointer.
      iii. Turn your body/compass until Red Fred is in his shed.
      iv. Walk the number of steps in a straight line that the direction of travel arrow is pointing.
      v. Look in the nearby area for the next sign.

4. If you had more than two groups, try having the groups switch again to try another course!

5. Congratulate everyone on completing an orienteering course!
Step 2:  How do maps, coordinates, and GPS systems work

Materials Needed:
- Globe (optional)
- Longitude/Latitude map of the World – See resources (1 per girl)
- Longitude/Latitude map of the USA – See resources (1 per girl or small group)
- Longitude/Latitude map of Utah – See resources (1 per girl or small group)
- Topographical Map of a specific place in Utah – Trefoil Ranch (1 per girl or small group)
  - If you would like to look at a map for a different location you can find free downloads here: http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&xcm=r3standa
rpditrex_prd&carea=%24ROOT&layout=6_1_61_48&uiarea=2)/.do
- Paper
- Pens/markers
- Large sheet of paper/poster board
- GPS system – can be a cell phone if it tells you longitude/latitude

Lesson Plan:
1. “Now that you girls are compass experts, we are going to start to learn about GPS’s and maps. These are a little more complicated in how they all work together, so today we are going to learn more about the big picture of how everything works. Are you girls ready?”

2. Start by handing out a piece of paper and a pen/marker to each of the girls. Explain that they will use this to write down their ideas later on.

3. First, hand out the map of the world (see resource section) to the girls.
   - Have them share what they know about the different lines on the map from school.
   - Ask them questions about different things on the map, see if they can come up with answers or guess about different parts.
   - Try to lead them through questions and not just lecturing answers at them.

4. Some things to touch on about this map:
   - **Circles have 360°** Since the Earth is a sphere it is also 360° around.
   - **Latitude lines** run horizontal around the globe.
   - **Longitude lines** run vertical around the globe.
     - If you go follow one line of longitude (or latitude!) around the map (or globe), and stop in the same spot, you will have crossed 360° of latitude (or longitude, the opposite of what you were following).
   - The **Equator** is the center line of latitude.
     - It is 0°N/S.
     - As you go above the equator, the lines are labeled with a degree number and N for North up to 180° when you hit the North Pole.
     - The same goes for going below the equator, except they are the South latitude lines leading to the South Pole.
   - The **Prime Meridian** is the center line of longitude.
     - It runs at 0° E/W.
     - As you go left of the Prime Meridian the lines are labeled with a degree number and W up to 180° when you hit the International Date Line.
iii. The same goes for going to the right of the Prime Meridian, except they are the East longitude lines leading also to the International Date Line.

iv. Fun fact: In 1884 the International Meridian Conference decided where the Prime Meridian would run. They could have chosen anywhere on earth! They chose to have it run through the Royal Observatory in Greenwich, England.

5. Have girls locate and label the following on their maps: Longitude, Latitude, Equator, Prime Meridian, and International Date Line.

6. “Great job girls! If we were going hiking do you think this map would be very helpful?”
   a. “No? You’re probably right, so we need to find a map that is closer to where we want to go hiking.”
   b. “Looking at the longitude and latitude lines, I want you to write down your best guess of where Utah is degree wise. So you would write X°N X°W on your paper.”
   c. After girls have their answers written down, have a few girls volunteer to share their answers.
   d. “Way to use the other lines for clues on where Utah is located on the degrees of longitude and latitude!”

7. Hand out the map of the United States (see resource section) to each girl or small group.
   a. “Now let’s look at this map. It’s a little more zoomed in where we can see the United States. Who can tell me which numbers are longitude and which ones are latitude again?”
   b. “Great job! Now that we have a more zoomed in map, we’re all ready to take it hiking right?”
   c. “No, we need a more detailed one? You girls are probably right.”
   d. “Before we move onto a more detailed one, let’s see how we’re doing on our guesses of longitude and latitude.”
   e. “Looking at this map, can you figure out what Utah’s longitude and latitude would be? Is it close to what you guessed by looking at the map of the world earlier?”
   f. “Wow great job girls! Now I want you take your best guess of where (pick your location for your final topographic map, we will use Trefoil Ranch for our examples) Trefoil Ranch is in Utah (it is by Provo, UT). Write your guess on your sheet of paper next to your old guess once again using X°N X°W.”

8. Hand out the map of Utah to each girl or small group.
   a. “Alright girls, you’ve asked to go smaller so I’ve got the state of Utah as our map. Does this look better? Can we go hiking from this map?” “No? Okay but what can we tell?”
   b. Have girls guess what the coordinates of the city they are from is.
   c. Have the girls once again guess what the coordinates of Trefoil Ranch is (it is by Provo, UT).

9. Ask the girls “What do we find on a map that is one degree on all sides? Looking at this map do you think that would be zoomed in enough?”
   a. “No? That’s right. So do you have any ideas on how we can measure things even smaller?”
   b. “After degrees, maps start to get measured in minutes. So I want you to imagine that degrees are now hours. How many minutes are there in an hour?”
   c. “60! That’s right! There’s also 60 minutes in a degree. Now what if we go smaller, what goes into minutes?” “Seconds! Great! How many seconds?”
   d. “60 seconds as well! They kept this the same on maps. But they go even smaller sometimes dividing things out into tenths and thousandths of seconds if needed!”
10. Hand out the topographical map of Trefoil Ranch (see resource section).
   a. Have girls take a moment and just look over the map.
   b. Ask them what they can figure out from just looking at the map – it can be anything! It doesn’t just have to be about Longitude and Latitude.
   c. Non-Latitude/Longitude things to note:
      i. The map includes a scale and a legend/key as the maps did that we were looking at in the Brownie Navigation steps. See if girls can find the different parts labeled in the legend on the map. Are they able to measure the distance of a trail or road?
      ii. All USGS topographic maps will tell you which maps are on all sides of the current map by using this symbol. This helps you to figure out which maps to use if you are crossing out of bounds of the current map you are using.
      iii. The magnetic North Declination:
         ▪ Remember when we were learning about compasses and we learned how the needle always points to the magnetic pull at the North Pole?
         ▪ Well fun fact! The magnetic North Pole is slightly off from the geographic North Pole!
         ▪ So this symbol shows the difference in declination to take into account when orienting your map North in advance map and compass navigation.
         ▪ For most outdoor trips, the difference is so minimal it doesn’t make much of a difference.

11. First thing to look at is how much land this covers. The map cover’s 7.5 minutes both directions as it states here:
    a. That means it is 7.5 minutes out of the 60 minutes that make up the degree. So it is very zoomed in from where we started with viewing the whole world!

12. Have the girls find a degree marking on the maps. They look like this:
    a. The easiest ones to find are in the corners.
    b. °= Degree, ‘=Minute, “=Second
13. Have the girls circle all the degree and minute markings they can find on the map (there should be a N and W in each corner and 2 more minute markers on each side)
   a. **Note: Ignore these numbers for now (40s to 60s written on the sides):**
   b. These numbers are used as part of a different grid method called Universal Transverse Mercator (UTM) system.

14. Have girls try their best guess of what degree, minute, and second N and W Trefoil Ranch is located at (have them look for Lightening Peak as Trefoil Ranch is close to that area).
   a. Our best guess is 111°30'45"N 40°18'45"W
   b. Have girls compare all their guesses (Starting from the world, to the United States, to Utah, to the minute map). How close was their original guess?
   c. Have girls pick out other locations on the map and try and figure out the coordinates for these places as well!

15. So we can find our coordinates on a map, and a GPS can find our coordinates on a map. But how do GPS's do it?
   a. GPS stands for Global Positioning System.
   b. GPS's connect to satellites that are circling the globe (there are 24 satellites total)
   c. A GPS intersects signals that are sent off by the satellites. These signals include information about the satellite’s position and current time.
   d. When a GPS intersects signals from multiple satellites (typically 3) the GPS uses the information of how far the satellites to create circles of the area the satellite is covering.
   e. The location that all three satellites intercept is where the GPS is currently located at and will give you those coordinates in Degrees, Minutes, and Seconds (if not more!)
   f. If you are unsure where you are at on your map, you can then use your GPS coordinates and map reading skills to find where you are!

16. Now when you are geocaching, you will have a better understanding of what all the numbers mean!

**Step 3:**
**Create a geocaching course**

**Materials Needed:**
- GPS unit (1 per girl)  
- Paper  
- Pens/markers  
- String to tie signs to different objects  
- Writing surface (optional)

**Lesson Plan:**
1. Begin by learning how to use/reviewing how to use a GPS. (Not all GPS units are the same, but most have similar functions. These steps are based off the GPS units you can check out from the Girl Scout Office).
   a. Note: As discussed earlier, GPS units need satellites to determine their location. Most GPS systems don’t work well indoors because the signal is not direct. When using your GPS, standing outdoors in an open area will sync your GPS to the satellites quicker.
   b. Turn the GPS on by holding the bottom right button (1).
c. Have the girls flip through the pages by pushing the top right button (2).

d. Some pages to note for this activity:
   i. **Satellite** This will tell you when you have connected to enough satellites to navigate. When ready “Ready to Navigate” will appear.
      1. **Accuracy:** GPS systems can only be so accurate. The GPS will tell you how close it will get you to the destination. You will need to do some searching within that distance in all directions to find your destination.
      2. **Location:** Does this look familiar? This will be your Longitude/Latitude Degree location.

   ii. **Main Menu** This will allow you to mark waypoints and find waypoints you have already marked while creating your course.

e. How to **mark a waypoint** From the main menu screen, toggle the joy stick (4) and select “Mark.” The screen to the right should appear on your GPS. Girls will be able to rename the point by hovering over the “001” and clicking it. Clicking “OK” will save the waypoint.

f. To find waypoints that have been marked select the following: Find ➔ Waypoints ➔ By Name

g. Select a way point. A new screen will pop up, have the girls select “Go to” and follow the instructions on the screen.
   i. Remember, GPS systems are not completely accurate. They will get the girls in the general area. Girls will then need to explore some to find the cache.

h. To change the screen, press the top left button (2) to scroll through until the main menu pops up again. Repeat the steps to find the new way point.
2. Explain to the girls: “Now we are going to create our own geocaching courses using our GPS skills!”
   a. Split the girls up into small groups (3-4 girls per group).
   b. As a group, they will work together to create a geocaching course for other girls to follow.
      i. Note: It may be useful to color code markers/paper with one color per group so girls can follow the correct course more easily.
   c. How to set-up a course:
      i. Have girls come up with a 5 letter word.
      ii. Find a starting object (it can be a tree, light post, cabin post, etc.)
      iii. Stand next to the object.
      iv. Go through the steps learned above to mark a waypoint on the GPS.
      v. Have them rename the waypoint to something like A1, A2, A3, A4, and A5. Some GPS units might have a lot of way points already stored. This way when they hand of their GPS unit to the next group they can tell them to follow the A’s.
      vi. On the sign (index card sized paper or smaller) write the first letter of their selected 5 letter word.
      vii. Have girls find a second object to mark as a waypoint. (Hint: Since GPS systems aren’t completely accurate, having girls select objects further apart [at least 30 feet for good measure] for more success with their course).
      viii. Have girls continue to find 5 different way points and write one letter from their selected word on each sign – until all letters of the word are written on signs.

3. When all the groups have finished setting up their courses, have the girls meet back together. Have the girls stay with their groups and try to follow another group’s course. Have the girls exchange GPS units in order to follow a different course.
   a. Inform girls that locations will be approximate since GPS’s aren’t completely accurate.
   b. How to follow the course:
      i. Have the girls scroll to the main page.
      ii. Select: Find → Waypoints → By Name
      iii. Have girls go to all the stops in GPS and write down the letters they find at the signs and put together the word that the other group thought of!

4. If you had more than two groups, try having the groups switch again to try another course!

5. Congratulate everyone on completing a geocaching course!

**Resources:**

Various Maps
The map for Trefoil Ranch is difficult to read in this document. Please download a cleaner image at (you can also have it displayed on your computer for the girls to see easier):
http://store.usgs.gov/b2c_usgs/usgs/maplocator/ctype=areaDetails&xcm=r3standardpitrex_prd&carea=%24ROOT&layout=6_1_61_48&uiarea=2)/.do
Outdoor Skills Patch
Navigation – Cadettes

Learn the skills needed to thrive in an outdoor environment. Do you know how to use different navigation techniques? Do you want to learn all about topographic maps?

PLEASE NOTE:
• Compasses and GPS units are available at the Salt Lake City Shop for rental.

Step 1:
Learn how to read a topographic map

Materials Needed:
- Topographic Map – see resources (1 per girl)
- Topographic Matching Handout – see resources (1 per girl)

Lesson Plan:
1. Gather the girls up and explain “Today we are going to learn how to read a topographic map. When you are going hiking in the backcountry, especially if you are not following trails, having a topographic map, knowing how to read it, and knowing how to use it is one of the greatest resources you could have. So here we go!”

2. Pass out a Trefoil Ranch topographic map to each girl. You can also go to: http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&xcm=r3standardpitrex_prd&carea=%24ROOT&layout=6_1_61_48&uiarea=2)/ and find a map of your current location or any location.
   a. Throughout this step, we will be showing examples from the Trefoil Ranch (Bridal Veil Falls) map. If you are using a different map, look for similar examples before beginning this activity with girls.

3. Throughout this step, have the conversation be as girl led as possible. Ask leading questions to get the girls to look at and think about what the different parts of the map mean. After they have had a chance to share what they know, guess, and infer what the different parts mean. Share the supplemental information provided here.

4. “First we are going to start with identifying the different parts on the outside of the actual map. Who can tell me what information we can find around the edges of the map?”
   a. Tells us **which Quadrangle Map** we are on: Makes sure we are looking at the right place! Especially helpful when carrying more than one map on a trail. Also tells us how much land the map covers. In this case 7.5 minutes by 7.5 minutes. (Relating back to Longitude/Latitude)

   b. **Legend:** tells us what the different symbols on the map mean. Specifically road types. Challenge: Have girls try and find two different road types on the map!
c. **Quadrangle location**: Tells us the general location of where we are in the state, as well as what the adjoining quadrangles are. Helps us connect maps if we are working off more than one.

![Quadrangle location diagram]


d. **Scale**: Tells us how far the distance on the map represents in real life. Provides different scales for measuring distance on the map. Tells us the contour interval to help determine steepness and altitude on the map.

![Scale diagram]


e. **Magnetic North Declination**: Tells the difference to take into account for True North versus Magnetic North and how to orient your map to get the most accurate reading.

![Magnetic North Declination diagram]


f. **Map history**: Tells you about when the different information for the map was collected and by what agency. This part helps match GPS systems with the correct map datum.


g. **Longitude/Latitude reading**: Helps you locate yourself especially when working with a GPS or when explaining your location to others.

![Longitude/Latitude reading]


h. **UTM reading**: A different grid system than longitude/latitude. The UTM system divides the Earth into 60 different zones each with a six-degree band of longitude. This system is based on a 2-dimensional system and does not take the curve of the Earth into account. Using this system on a map can often result in more accurate locations due to the smaller scale.

![UTM reading]


i. UTMs are measured in Northings (indicating the exact position in a north-south relationship) and Eastings (indicating the east-west relationship).
   1. Increasing easting numbers indicate you’re heading east; decreasing mean you’re heading west.
   2. Increasing northing numbers indicate you’re heading north; decreasing mean you’re heading south.
ii. The first number indicates hundreds of thousands of meters. Ex: \(445\,900 = 4,459,000\) meters. This number is smaller, because it is least likely to change while taking coordinates.

iii. The large numbers indicate thousands of meters. Since 1,000 meters = 1 kilometer, each tick is 1 kilometer apart.

iv. The last three numbers indicate hundreds of meters. Some maps may have 500 meters marked.

v. The squares the grid create can be broken down by your best guess of what hundred meter mark they fall at. For example, if on a 1,000 meter square it looks like a place is about 1/3 of the way up the square you could say it’s at 300 meters.

vi. To name a location, you would simply name the Northing and Easting closest to what it falls. So if we were to give a UTM location of Trefoil Ranch our best estimate would be 4463400N 456300E.

vii. Give girls 3 different locations to try and find on the map and name the Northing and Easting for those locations.

5. “Great job girls! Now that we know what everything on the outer parts of the map mean, we can talk about the map itself.”
   
a. **Words**: Represent various landmarks/points of interest to keep you oriented.

   ![Snow Slide Canyon](image)

b. **Yellow and black dotted lines**: County boundaries

   ![Wasatch Co. Utah](image)

c. **Colors**

   i. Blue: Water source (rivers, lakes, ponds, etc.)

   ii. Green: The area is vegetated (woods, scrub, etc.)

   iii. White: No/very little vegetation (desert, sand, rocks, boulders, etc.)

d. **Contour lines**

   i. Contour lines are all the brown lines covering the map. These lines help show the layout in the land and the elevation levels. The different ways that lines interact with each other show different features.

   ii. It is important to note the interval between contour lines (found at the bottom of your map. On the Bridal Veil Falls map, the interval is 40 feet.

   iii. Lines further apart: This shows that the land is generally flatter and/or has less of a slope associated with the area.

   ![Bridal Veil Falls](image)

   iv. Lines very close together: This shows that the land is either very steep or has a sharp drop off.
v. Lines that enclose to a circle: Shows a peak or high point in the land. Or low point (depending on elevation changes)

vi. “V” patterned lines pointing towards higher elevations represent canyons or gulleys (these often have water through them or were formed by water sources)

e. Have girls practice locating different features on their map. Have girls get into pairs or small groups to give and find different features to each other.

6. Additional ideas to help explain contour lines to girls if they are having difficulties.

7. Know it’s time to test their contour line expertise! Pass a contour matching worksheet (see resource section; originally from Be Expert with Map & Compass) out to each girl and see if she can match the contour lines to the shown peaks.
   a. Answers:
      i. A = 6, B = 1, C = 4, D = 3, E = 2, F = 5

8. “You girls are all great map readers! Now the best way to remember how to read a map is to practice, practice, practice. And we’ll keep learning more about maps as we continue in our navigation section!”

**Step 2:**

Build landforms and create a topographic map.

**Materials Needed:**
- Air Dry Clay (or other quick drying clay)
- Wax Paper (to let the clay sit on)
- Paint/Paintbrushes
- Paper
- Colored Pencils
- Rulers/tape measures
- Topographic map examples
Lesson Plan:
1. “Alright girls, do you remember about learning about topographic maps last time? Perfect! Let’s review one just to refresh our minds!”
   a. Review the different parts of the topographic map (including the parts on the outer parts of the map). If you need help remembering the different parts, refer to Cadette Navigation, Step 1.

2. “Awesome! Now that we’ve reviewed maps, we’re going to create our own maps, while first getting our hands a little messy. We’re going to create our own land that we will then draw topographic maps from.”

3. Have the girls create their landscape they want to map using a section of air dry clay.
   a. Girls can design their area however they wish, it can be an island, in the center of a continent, or a shore somewhere! It can be based off a real location or it can be completely made up.
   b. Each girls landscape should include:
      i. At least one area with vegetation, one area with water, and one area with no vegetation.
      ii. At least 7 different landforms with at least 5 of those landforms being unique. Landforms can include (but not limited to): mountains, canyons, mesas, lakes, cliffs, rivers, swamps, prairies, valleys, etc.
      iii. It should include landforms of various heights and steepness as well.
   c. Let the girls take it away and have fun!
   d. Allow the clay to dry – if you are using air dry clay you will need to wait overnight or longer. Some clay recipes can be dried in ovens if you want a faster drying time.
   e. Once the clay is dry, have the girls paint their landscapes – just for fun! They are welcome to paint them however they want (if they want a field of colorful flowers, go for it!). Make sure girls include their areas of water, vegetation, and no vegetation.
   f. Once the girls have their landscapes formed and painted, it is time to start making maps!

4. Give the girls a sheet of paper to outline what their topographical map would look like.
   a. Girls should determine a general location of where they want their landform to be. Please have girl’s pick someplace within the United States so their map can be consistent with the one’s they are learning from.
   b. Have girls find the highest point on their landform and assign it an elevation. Have the girls find the lowest point on their landform and assign it an elevation (encourage girls to have some significant elevation change, ex: at least 2,000 feet to use more contour lines).
   c. Using a ruler/tape measure create a scale and start finding your intervals for contour lines.
i. Map contour intervals are dependent on how changing in elevation the area is. (Steeper lands will use larger intervals, flatter land will use smaller intervals).

ii. Typical contour intervals: 10 feet, 20 feet, 40 feet, 80 feet, 100 feet.

d. Have girls draw contour lines on their map.
e. Have girls use different colors to represent vegetation and water.
f. Have girls label important features on their map (ex: peaks, rivers, roads, etc.)
g. For even more fun – have girls look up longitude/latitude and/or UTM for areas nearby where they’ve chosen and add coordinates to your grid.

5. Show off their mapping skills to friends or family.

**Step 3:**
**Follow a trail using your map and compass skills**

**Materials Needed:**
- Hiking Area and a topographic map of that area (1 per girl or small group)
  - Larger maps work better
  - Download topographical maps by Googling “USGS map locator” or using the link below: http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&xcm=r3standardpitrex_prd&area=%24ROOT&layout=6_1_61_48&uiarea=2)/do
- Compass (1 per girl or small group)

**Lesson Plan:**

1. “Today, it is all about putting your skills to the test and seeing what you have learned. We are going to take our map and compass skills to the trail!”
   a. When you first arrive at the trail, divide girls out into small groups (3-4). These will be the groups they will be navigating with throughout the day.
   b. Have the groups try and orient their map North and find where they are at in relation to the things they see on the map.
   c. Have girls trace out the trail they are going to be following on the map – by either drawing the trail on the map or highlighting the trail if it is printed on the map.
   d. Have the girls think about what they might be able to see while hiking on the trail. Will there be any mountain peaks? Any canyons? Any water sources you might pass?

2. Begin hiking your trail! Have groups take turns leading the hike while following their map.
   a. At least 6 times during the hike, have groups stop and try and locate where they are precisely on the map by matching the contour lines with what they see around them. Have girls orient their map North first.
   b. Are there any disagreements on locations between the groups? Have them work together to figure out their location.
   c. Depending on the length of your trail, you can have your group stop more times.

3. After your hike ends, talk about how using the maps and compass on the trip went.
   a. What were some struggles the groups had while trying to use the map?
   b. What were some success that the groups had while using the map?
   c. How did using a map while hiking change your experience? Were you able to see more? Less? What did you focus on?
d. Do you feel if you were lost, yet had a map and compass would you be able to find your way?

e. What do you think you need to learn more about or practice more to help you with your navigational skills?

4. “You girls did great working with your maps and compasses and with your team! You are all going to become great backcountry navigators one day.”

**Resources:**

**Bridal Veil Falls Topographical Map**

**Contour Matching Worksheet**

The map for Bridal Veil Falls/Trefoil Ranch is difficult to read in this document.

Please download a cleaner image at (you can also have it displayed on your computer for the girls to see easier):

[http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&xcm=r3standardpitrex_pr d&carea=%24ROOT&layout=6_1_61_48&uiarea=2)/.do](http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&xcm=r3standardpitrex_pr d&carea=%24ROOT&layout=6_1_61_48&uiarea=2)/.do)
Outdoor Skills Patch
Navigation – Seniors & Ambassadors

Learn the skills needed to thrive in an outdoor environment. Do you know how to use different navigation techniques? Do you want to learn useful skills for when you’re lost?

PLEASE NOTE:
• Compasses and GPS units are available at the Salt Lake City Shop for rental.
• This guide is written in a way that a girl can pick it up and go through the steps without having a Troop Leader lead the session for her.

Step 1:
Write a trail plan using a topographic map

Materials Needed:
- Hiking Area and a topographic map of that area (1 per girl or small group)
  - Larger maps work better
  - Download topographical maps by Googling “USGS map locator” or using the link below: [link to USGS map locator]
- Paper
- Pens
- Compass
- String for measuring (can be attached to compass)

Lesson Plan:
1. Begin by reviewing how to read a topographic map. You can use the Cadette Navigation curriculum for a reference or use the internet to research it.

2. The goal of this activity is to have you write a detailed trail plan.
   a. The trail plan should be detailed enough that:
      1) You are able to leave it behind with someone and they could find you in the event of an emergency and
      2) You are able to navigate purely off the directions you write in the trail plan and compass without using a map.
   b. The travel plan should be written for a full day hike (6 or more hours, can be done for one or more days of a multiple day trip).

3. What to include in your trail plan:
   a. First and Last Names of the people hiking in your group (never hike alone; be sure your parent/guardian knows about this hike and approve you going).

   b. Group gear that people are carrying (i.e. first aid kit, GPS, permits, tent, stove, etc.).

   c. Origin and Destination
      i. Include the UTM coordinates of your origin and destination as well as a short description of where your locations are.
      ii. Not sure what a UTM coordinate is? Refer to the Cadette Navigation curriculum or research it online.
d. **Route**
   i. This is the most detailed part of your trail plan. You will write out what you will see while you are hiking, any important land features you will pass, and distance between features.
      1. To determine distance on a map, use a piece of string to follow all the curves of the trail and then measure the distance of the string laying straight on the scale at the bottom of the map.
   ii. Remember – You will be navigating using only these directions and without a map (you will have a map with you for emergencies).
      1. Ex: From camp head South up Woodenshoe Canyon. Encounter a drainage from the East in \( \frac{1}{4} \) mile. Continue South around a westward bending horseshoe then continue South. We will encounter 2 drainages, one from the East and one from the West...
      2. Ex: After drainage, continue Southeast encountering trailhead in 1 mile exiting Woodenshoe Canyon. Horse Corrals will be on the west side of the trailhead. At trailhead, head Southwest for \( \frac{3}{4} \) mile (off-trail) until encountering a 4-Wheel Drive Road (#0181)...

e. **Mileage**
   i. Total Mileage: Number of miles to be hiked
   ii. Travel Time: The time your group anticipates it will take while hiking
      1. On average, a backpacker covers about 2 miles per hour on flat-moderate terrain.
      2. People carrying light loads (day packs) cover about 3-4 miles per hour on flat-moderate terrain.
      3. Hiking on steep terrain adds about \( \frac{1}{2} \) - 1 hour to all times.
   iii. Total Break Time:
      1. How long do you think you’ll stop for breaks throughout the day?
      2. Three 20-minute breaks = 60 minutes total break time
   iv. Total Travel Time: Travel Time + Total Break Time = Total Travel Time
   v. Estimated Time of Departure: What time are you expecting to begin hiking?
   vi. Estimated Time of Arrival: What time are you expecting to be done hiking?

4. Once you have your Travel Plan written out, it’s time to hit the trail! Leave one copy behind for safety and take the other with you on your trip.
   a. Try to navigate using only your travel plan. How far can you go on your hike using just your trail plan?
   b. **Pack a topographical map with you as well.**
   c. If you become unsure of where you are or think you may be lost, pull out the topographical map you brought with you. There is no need to become in an emergency situation while trying to do a fun challenge.

5. After your hike, see how you did!
   a. Were you close with your travel times you guessed?
   b. How did you do following your description?
   c. Were there things you wish you would have written but didn’t?
   d. How did your group work together?
   e. What is something with Navigation you wish you could learn more about or practice more?

6. Congratulations on hiking from a trail plan! A feat that only few do!
Step 2:
Learn how to use natural items to help with navigation

Materials Needed:
- Compass
- Rocks/Sticks
- Optional: Laser pointer (to help point to stars in the sky)

Lesson Plan:
1. What happens when you find yourself lost in the woods without a compass?
   a. Most people, who get lost in the woods, didn’t plan on it.
   b. Common instances of people getting lost are campers separated from their group, families searching for Christmas trees, or skiers that have taken the wrong trail. All things most people wouldn’t bring a compass for!
   c. So it’s important to be able to get your bearings in these situations.
   d. You are going to learn a couple of ways to help navigate through these scary situations.

2. First and foremost is knowing how the sun rises and sets.
   a. The sun rises in the east and sets in the west generally.
   b. But during most of the day the sun appears to be just generally overhead and it can take a while to watch the sun’s movements to determine the direction it is headed.
   c. So instead there is a method to help us track the movements.

3. Find the direction of the sun and North using a stick. Adapted from www.scoutsociety.org
   a. Put a tall stick in the ground and mark the top of its shadow with a rock or an X in the dirt.
   b. Wait 15 minutes and place a second rock/X at the tip of the shadow’s new location.
   c. Place your left foot on the first rock’s location and your right foot at the second rock’s location. You are now facing North!
   d. You can also draw a W at the first spot and an E at the second spot. Then draw a perpendicular line for North and South.
   e. Pull your compass out. How accurate to North were you able to get?

4. But what happens when the sun has set and you need to find North?
a. You can also use the stars to find your way!

b. Now we are going to learn how to find North while in the Northern Hemisphere.
   i. If you ever go to the Southern Hemisphere you’ll see different constellations and will use those to find south instead, but today we’ll just focus on the Northern Hemisphere.

c. Be sure to do this activity at night when it is dark outside and you can see the stars.

5. In order to find North, we need to find the star Polaris or the North Star. The easiest way to do this is by first finding the big dipper (see image below).

   Adapted from www.camping-field-guide.com

   a. Once you have found the big dipper, you will take the two stars on the cup of the ladle, opposite the handle, and draw a mental line extending outward.

   b. This line will intersect with Polaris. Then follow an imaginary line from Polaris, perpendicular to the horizon, and to the ground. This direction will be North.

   i. While facing North, you can now determine that East is directly to your right, South is directly behind you, and West is directly to your left.

   c. Fun Fact! Polaris is also the first star in the handle of the little dipper. See if you can find the little dipper after you have found Polaris.

   d. Using your compass, see how accurate the star’s North is compared to the compass.

      i. Which method was more accurate the sun or the stars?

      ii. Why do you think this is?

6. Other fun things to note!

   a. Help navigation by studying the vegetation

      i. In general, moss will grow on the North side of trees. And when looking at a mountain or valley, there will be more vegetation on the North facing side then on the south.

      ii. Note: This is very general and many factors influence moss and vegetation growth. This method should be used for fun or with one of the earlier listed methods to maintain your path and should not be relied on solely.

   b. If you need to follow North (or any direction) for an extended period of time, it is helpful to find a landmark to walk towards. This way if obstacles cause you to stray from the straight path you are able to line back up again.

      i. It may be helpful to find closer, more frequent landmarks to walk towards, versus one landmark a long distance away.

   c. How to tell how much daylight is left in the day.

      Adapted from www.backpacker.com
i. The last thing you want to do is find yourself in the dark unprepared. If you don’t know what time the sun is expected to set for the specific day, it may be useful to know approximately how many hours are left in the day. How do you do this? By using your eyes and hands!

ii. Look towards the sun (but not directly at it!). Hold your hand an arm’s length away and line up the bottom of your pinkie finger with the top of the visible horizon.

iii. Every finger up from the horizon is approximately 15 minutes.

iv. So if you hold both your hands out with one hand on top of the other and the sun is sitting just above the index finger on your top hand, you can be fairly accurate in assuming you have 2 hours left in the day.

Picture credit: www.appalachiantrails.com

7. Next time you’re exploring the outdoors, try some of these fun navigational tricks and impress the people you’re traveling with!

**Step 3: Learn how to do Triangulation**

**Materials Needed:**
- Compass
- Pencil
- Hiking Area and a topographic map of that area (1 per girl or small group)

Larger maps work better

Download topographical maps by Googling “USGS map locator” or using the link below:
http://store.usgs.gov/b2c_usgs/usgs/maplocator/(ctype=areaDetails&xcm=r3standardpitrex_prd&carea=%24ROOT&layout=6_1_61_48&uiarea=2)/.do

**Lesson Plan:**
*Images below are from the book “Compass and Map Navigator” by Michael Hodgson and illustrated by Jon Cox © 2000.*

1. Scenario: You’re hiking along and you haven’t been checking your map because you are sure of where you are going. Then you realize, you don’t recognize where you are and you must have gotten off-route at some point. Since you haven’t checked your map all day, you have no guide point of where you are. What do you?
   a. Share ideas and discuss different ideas of what you could do if you found yourselves in this situation.
   b. We’re going to learn one more tool to add to our belts when it comes to navigation.

2. Triangulation is the process of finding three landmarks and finding where they all intersect. The point of intersection is where you are.
3. The first step in triangulation is to pick three topographic features that you can see and identify on your map (mountains, peaks, lakes, low valleys, etc. are ideal!)

4. Orient your map North using your compass.

5. Start with one of the features.
   a. Using your compass take a bearing between you and the feature.
   b. On your map, draw a line using that same bearing extending from the feature to your general direction.
      i. Make a tick mark in the direction the direction of travel arrow is pointing when Red Fred is in his Shed.
      ii. Use the side of your compass to extend the line straight.

6. Do the same process for the second and third features.

7. The point (or small triangle) where the three lines intersect on the map is where you are!
   a. Depending on how accurate your bearings and how accurately you drew your lines, there will probably be some error in your location.
   b. Use your map reading skills to help find a more precious location. (If the lines intersect in a valley and you are on a hill, the location is obviously off a bit on the map).

8. Practice triangulation at least once more using three new object (you may need to go to a different location to find three good objects).