Classifying Stars

Goal:
To demonstrate that stars can be classified based on their properties. To show that these generalized categories are helpful, but only if the star is on the main sequence. If it is not, these categories break down.

Materials:
Representations of stars (we used paper circles of the correct color and approximate size, but balls, beads or anything else could also be used)
A means to sort the stars into categories (we used pieces of construction paper labeled with the spectral classes and a basic definition, but bins, buckets or anything else could be used)

Directions:
Begin by explaining the basic spectral classification system. You may want to start by only discussing color and add size later on. Or, for a shorter activity, you can introduce both at once (this was our choice).
Distribute the stars among the campers
Ask the campers to sort the stars into their spectral classes based on what they know about them (color and/or size, depending on what you've started with). You can have all the campers work with one set of bins, or give each camper/group of campers their own set (this was our choice)
If you started with only one characteristic, introduce the second one and ask them if they want to reclassify any stars or leave them alone.
Reveal the actual spectral class of each star. How many stars did they categorize correctly? Why did some end up in the wrong bucket? Be sure to stress that the basic assumption that spectral class tells you most of the properties of a star is only true if the star is on the main sequence of the Hertzsprung-Russell diagram (the most stable part of its lifetime).

Spectral Classes
The generalized basic spectral classes are:

Class	Color	Average Size (in solar radii)
O	blue	15
B	blue-white	7
A	white	2.5
F	yellow-white	1.3
G	yellow	1.1
K	orange	0.9
M	red	0.4

The 50 Brightest Stars from Earth

Name	Color	Size in Solar Radii	Spectral Class
Sirius	white	1.7	A
Canopus	yellow-white	65	F
Rigil Kentaurus	yellow	1.2	G
Arcturus	red	26	K
Vega	blue-white	2.3	A
Capella	yellow	12	G
Rigel	blue-white	78	B
Procyon	white	2	F
Betelgeuse	red	936	M
Achernar	blue-white	10	B
Hadar	blue-white	8	B
Altair	white	1.8	A
Acrux	blue-white	5.5	B
Aldebaran	orange	44.2	K
Spica	blue-white	7.8	B
Antares	red	800	B
Pollux	orange	8	K
Fomalhaut	white	1.8	A
Deneb	white	110	A
Mimosa	blue-white	8	B
Regulus	blue-white	3.2	B
Adhara	white	14	B
Castor	blue-white	2.3	A
Gacrux	red	113	M
Shaula	blue-white	6.2	B
Bellatrix	blue-white	5.7	B
Elnath	blue-white	5.5	B
Miaplacidus	white	5.7	A
Alnilam	blue-white	26	B
Alnair	blue-white	3.6	B
Alnitak	blue	20	O
Regor	white	13	O
Alioth	blue-white	3.7	A
Kaus Australis	blue-white	7	B
Mirfak	yellow-white	56	F
Dubhe	orange	30	F
Wezen	yellow-white	200	F
Alkaid	blue-white	1.8	B
Sargas	yellow-white	20	F
Avior	orange	153	B
Menkalinan	blue-whtie	28	A
Atria	orange	130	K
Koo She	blue-white	2.6	A
Alhena	blue-white	4.4	A
Peacock	blue-white	4.4	B
Polaris	yellow-white	30	F
Mirzam	blue-white	4.25	B
Alphard	orange	50.5	K
Algieba	orange	32	G
Hamal	orange	15	K

From this listing, it is clear that if the campers sort based on color alone, they will get most of them into the correct category. Adding size complicates the matter significantly, since there are many giant stars in among the 50 brightest visible from Earth which have long since left the main sequence. In fact, based on size, no stars in the group are smaller than the Sun, which would leave the K and M bins with no stars in them at all. Main sequence K and M type stars are extremely small and faint - none are in the 50 brightest stars from Earth. They would be extremely difficult to see unless they were very close to us. In this way, we also begin to introduce the concept of a selection effect, which will become important later on as we learn about finding exoplanets.