Virtual space exploration

BY BOB RIDDLE

Virtual reality (VR) and augmented reality (AR) technology allows the user to view distant places, as well as the world around us, in ways that were never before possible. VR creates an environment that you can explore while AR enhances our view of the real world, when viewed on a screen, by adding information text, imagery, and audio. Thanks to this technology, we can walk across the surface of distance planets, drive a rover across Mars, and take a tour of the International Space Station, all from the comfort of our classroom. Although these are relatively new technologies, there are many VR and AR resources available to the classroom teacher. (See Resources for two recent NSTA journal articles and a Go Crazy Science blog post that discuss VR and AR in the classroom.)

What you will need

You can experience VR and AR from a computer, smart phone, tablet, or through a specialized headset, either by visiting a specific online site or downloading an experience to be viewed at a later time. The headsets provide a more immersive experience, as they allow you to rotate your head in any direction to change your view as you would in real life. Exploring a virtual environment with a headset also gives you a better sense of the distance between objects in the environment, as well as their physical dimensions as you move through the environment. Expensive headsets incorporate the video and audio technology needed to create the virtual environment, but less expensive ones are available that house your smart phone and rely on it to provide the necessary input. For non-headset experiences, a mouse and keyboard or some other type of input is required to navigate a VR or AR experience.

Online virtual reality apps and websites

The New York Times has a large library of VR videos on a wide range of topics. The NYT VR app (see Resources) is available for Android and Apple and is required to view any of the selections from their library. All videos are available either as 360° videos or in a format requiring a VR headset that houses a smart phone.

Students can also develop their own virtual world with the online tools at the CoSpaces and Story Spheres websites (see Resources). Both sites have a large library of visuals developed by students and teachers that are ready to use or that could serve as examples for creating your own.

At CoSpaces, students and teachers can create their own 3-D virtual world, using the "Create Space" program and a large library of graphics. Other graphics and audio may be uploaded to CoSpaces. Objects in the CoSpaces may be animated or have audio and text appear when an object is clicked. Animations and other effects in the CoSpaces are controlled by a built-in programming code called "CoBlocks."

The Story Spheres website allows only 360° images in the .jpg or .jpeg format. Using a smart phone camera, take a 360° picture and upload it to the website. Once uploaded, different parts of the picture can be programmed to trigger a specific response when

clicked. This could be a narrated description of that part of the picture or sounds or music that play automatically when the cursor passes over them. There is a large collection of Story Spheres available for viewing on the website.

Augmented reality apps

Augmented reality brings objects into the real-world environment that we can manipulate and interact with through smart phone, tablet, or headset. AR with a smart phone camera gained widespread attention thanks to Pokémon Go. This game used the smart phone camera and GPS to determine the location of different characters and objects that were placed in your camera's display. Additionally, the popular social network app Snapchat uses AR technology for its feature that overlays floppy ears or other pictures or location information to the picture in the Snapchat camera display.

AR also has the ability to bring objects or places from space into the classroom. For instance, AR apps can overlay flight information and other graphics during coverage of a launch in real time; bring a spacecraft or other object into the room; or park a Mars Rover in a driveway (see Figure 1).

The following smart phone apps use AR. All of them place an interactive holographic model of your choice of a variety of space exploration objects into your camera's field of view and allow for the object to be manipulated.

November

2 Waning crescent Moon near Regulus
4 Daylight Saving Time ends
5 South Taurid meteor shower
6 Mercury at greatest eastern elongation
7 New Moon
9 Mercury near Antares
   Carl Sagan Day (see Resources)
11 Waxing crescent Moon near Saturn
12 Taurid meteor shower
13 Moon at descending node
14 Moon at apogee: 404,341 km (251,246 mi.)
   Venus near Spica
15 First quarter Moon
16 Waxing gibbous Moon near Mars
17 Leonid meteor shower
   Asteroid Juno at opposition
18 Astronaut Alan Shepard's birthday (1923) (see Resources)
21 Linda Morabito's birthday (1953) (see Resources)
23 Full Moon
   Moon near Aldebaran
26 Jupiter in conjunction with the Sun
   Moon at perigee: 366,623 km (227,809 mi.)
27 Moon at ascending node
   Mercury at inferior conjunction
29 Mercury at perihelion
   Waning gibbous Moon near Regulus
30 Last quarter Moon

December

3 Waning crescent Moon near Venus
5 Waning crescent Moon near Mercury
6 Mars near Neptune
7 New Moon
9 Waxing crescent Moon near Saturn
10 Moon at descending node
11 Richard Garriott buys Russian *Lunokhod 2* rover (see Resources)
12 Moon at apogee: 405,177 km (251,765 mi.)
14 Geminid meteor shower
   Waxing crescent Moon near Mars
   Laura Ingalls's birthday (1893) (see Resources)
15 Mercury at greatest western elongation
   First quarter Moon
21 Waxing gibbous Moon near Aldebaran
   Close Mercury and Jupiter conjunction
   December solstice 5:23 p.m. EST (22:23 UT)
22 Mercury near Antares
   Jupiter near Antares
   Full Moon
   Ursid meteor shower
24 Moon at perigee: 361,060 km (224,352 mi.)
   Moon at ascending node
26 *InSight* lands on Mars
   Twin CubeSats flyby of Mars
   Waning gibbous Moon near Regulus
   Venus at perihelion
29 Last quarter Moon

FIGUREE 1: Augmented reality of Mars *Curiosity* rover

Visible planets

Mercury will be over the western horizon at sunset during November. After moving through inferior conjunction at the end of November, Mercury will reappear as a morning planet during December. Mercury will not be easily seen during November as it will be low over the western horizon. However, Mercury will be visible as a morning planet in December.

Venus will become increasingly more visible as a morning planet as it rises earlier, ahead of the Sun.

Mars will remain visible over the southeastern horizon during November and December. However, as the distance between the Earth and Mars increases, Mars will gradually start appearing less bright.

Dwarf planet **Ceres** will be above the eastern horizon at sunrise, but will only be visible with large optical aids or time exposure pictures.

Jupiter will move into superior conjunction, on the opposite side of the Sun, and will not be visible until later in December where it will re-emerge as a morning planet and rise before the Sun rises.

Saturn will be low over the western horizon at sunset and will be increasingly closer to the setting Sun as Saturn moves toward solar conjunction just after the New Year.

Spacecraft AR app

With the NASA Spacecraft AR app (see Resources), you may select from an Earth-orbiting satellite, the Mars *Curiosity* rover, the *Cassini* spacecraft; the *Voyager* spacecraft, the *Juno* Jupiter orbiter, or a 70-m (230 ft.) Deep Space Network antenna. Most of these may be displayed either in a mini size or actual size, and each includes additional information about the object. Each projection allows you to walk around the object as if the object were physically there. This app could make for interesting group pictures or an investigation comparing the objects set to real-life proportions near the school building, gymnasium, or a school bus. The app is currently only for Android-based smart phones.

Spacecraft 3D app

This NASA-developed AR app has a large selection of spacecraft, satellites, and antennae to choose from. Once a selection is made, the app puts an interactive holographic projection of that object in your camera field of view. The projected image is a three-dimensional graphic that is so small that it looks best on a table or desktop. The three-dimensional image may be rotated in all directions and resized by zooming in or out. Each object has an extra page with interesting information and facts (see Figure 2). The app is available for Android and Apple devices.

321 Launch app

Developed by *USA Today,* this app uses AR to create a holographic

FIGURE 2: Palm-size *InSight*
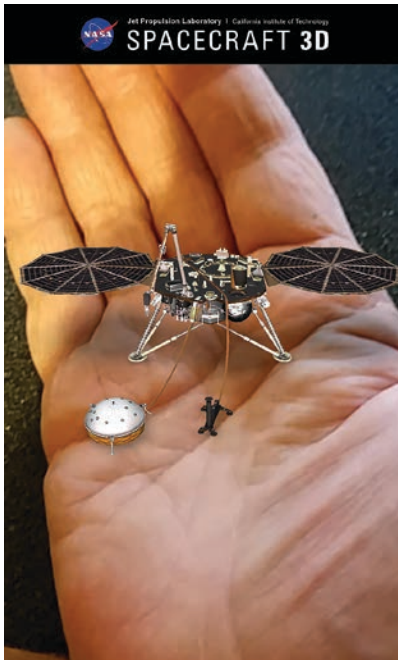
display of a launch facility where the user prepares a SpaceX rocket for launch. To initiate the launch, choose "Launch Simulation" and find a flat surface for the app to display the holographic imagery. During this simulation, a voice will describe each step and provide guidance as you assemble the rocket and prepare it for lift off and a return landing back to Earth.

This app also links with the *Florida Today* website for information about launches and current space news. Live coverage of launches may be viewed with app. During an actual launch, additional AR imagery is added, including buildings around the launch pad and other scenery. The app is available for Android and Apple devices. ●

RESOURCES

321 Launch—*play.google.com/store/apps/details?id=com.usatoday.spacear*
Alan Shepard—*www.jsc.nasa.gov/Bios/htmlbios/shepard-alan.html*
Carl Sagan Day—*www.daysuntil.com/Carl-Sagan-Day/index.html#Carl-Sagan-Day-260574*
CNN Archives—*www.cnn.com/specials/vr/vr-archives*
CNN-Losing Dark Skies—*www.cnn.com/2017/11/06/vr/endangered-starry-sky-zion-national-park-vr/index.html*
CoSpaces—*cospaces.io/edu*
Cyril Jackson—*web.archive.org/web/20060114143043/http://www.saao.ac.za/assa/html/his-astr_-_jackson_c.html*
Go Crazy Science blog post—*www.gosciencecrazy.com/blogs/blog-science-crazy/how-ready-are-we-for-ready-player-one*
Google Cardboard—*vr.google.com/cardboard*
InSight Mission—*mars.nasa.gov/insight*
Laura Ingalls—*web.archive.org/web/20091028152227/http://www.geocities.com/~wallyg/ingalls.htm*
Linda Morabito—*www.lindamorabito.com*
NASA ExoPlanet Travel Bureau—*exoplanets.nasa.gov/alien-worlds/exoplanet-travel-bureau*
NASA mobile apps—*eyes.nasa.gov/mobile-apps.html*
NSTA article about AR—*www.nsta.org/publications/news/story.aspx?id=58154*
NSTA article about VR "Extending Education Virtually" (p. 8)—*http://static.nsta.org/pdfs/nstareports/nstareports201609.pdf*
New York Times Augmented Reality app—*nyti.ms/2re1YAz*
New York Times AR: Explore InSight—*www.nytimes.com/interactive/2018/05/01/science/mars-nasa-insight-ar-3d-ul.html*
New York Times "Daily 360"—*www.nytimes.com/video/the-daily-360*
New York Times "Life on Mars"—*www.nytimes.com/video/360-lifeonmars*
Richard Garriott—*www.nytimes.com/2010/03/31/science/space/31moon.html*
Spacecraft 3-D—*play.google.com/store/apps/details?id=gov.nasa.jpl.spacecraft3D*
Spacecraft AR—*play.google.com/store/apps/details?id=gov.nasa.jpl.spacecraftAR*
SFA Starcharts—*observe.phy.sfasu.edu/SFAStarCharts/SFAStarChartsPro.pdf*
Story Spheres—*www.storyspheres.com*
Tour the International Space Station—*www.esa.int/Our_Activities/Human_Spaceflight/International_Space_Station/Highlights/International_Space_Station_panoramic_tour*
Women in Space—*history.nasa.gov/women.html*

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For students

1. Create your own virtual world with CoSpaces to explain something relating to your science class.

2. Use a smart phone camera to take a 360° picture and save it in the .jpeg or .jpg graphic format. Upload the picture to the Story Spheres website and add comments and audio to make the picture interactive.