Blended learning strategies combined with innovative technology, for example, virtual reality (VR), can be used in science classrooms to differentiate teaching and enrich learning experiences. The positive impacts of differentiated instruction in a classroom can lead to a better understanding of science content and improved inclusivity. Blended learning station rotation models allow multiple groups to work on different materials at the same time, while station rotations provide teachers the flexibility to incorporate collaboration, technology-focused learning, and small-group instruction.

VR is a popular addition in STEM education due to its interactive and immersive capabilities. Various VR experiences include computer generated 2D videos, 3D headsets that require smartphones, and fully immersive 3D head-mounted devices (HMDs) that require computers or all-in-one hardware. Smartphone headsets and HMDs use gyroscopic sensors (head tracking) to display stereoscopic (3D) images that give users the illusion of movement. The lower cost smartphone headsets lose capabilities, such as surround sound and handheld haptics, but allow for an affordable addition into a classroom to view 360° videos. This article will explain how to utilize blended learning’s station rotation pedagogical strategy to equitably integrate VR in a cost-effective manner for teaching content-flexible lessons. See box for more information about VR.

Preparing for station rotations

First, decide on the number of groups and which rotational model to follow. In this example, the three centers rotational model (Figure 1) was utilized to allow for teacher-directed, small-group instruction, collaboration, and independent digital content. The three centers rotational model involves students rotating through three different stations that provide differentiated instruction and personalize the learning experience for students.

Centers are a valuable addition to the classroom because they allow teachers to utilize three or more “mini lessons” in one class period. Within the three centers lesson, teachers can work with small groups rather than the entire class. Additionally, students can practice being self-directed learners in independent digital content and build social skills in collaboration. As demonstrated in Figure 1, the three rotational activities run concurrently with students switching to the next activity after a set amount of time.

To prepare for station rotational activities, teachers will group students homogeneously or heterogeneously based on student data (e.g., exit tickets, unit tests, state test scores, Lexiles, interests, learning style preferences, prior knowledge on the topic, student strengths/skillsets, etc.). A science classroom with 24 to 30 students, for example, can be divided into three groups of eight to ten students. For larger classes, the students within a grouping can be subdivided even further (e.g., nine students are placed into three collaborative groups of three students) to ensure that each student
is contributing to the assignment. In this example, I split students into low-mid-high performing groups of three (based on students’ test scores) as a strategy to provide more individualized instruction dependent on students’ specific learning needs.

It is suggested to spend 5–10 minutes on a whole-class introduction about the topic and to review the rotational activities instructions and expectations, 10–15 minutes for each rotational activity, and 5–10 minutes on a closure activity to complete a lesson within a 60-minute block. This blended learning rotational model works at any school level, from elementary to college classrooms. The following rotation example includes information related to a middle school lesson on cells; however, the three centers rotational model is applicable to other lessons to differentiate instruction based on content and ability levels.

**Teacher-led, small-group rotational activity**

This rotational activity requires the preparation of three activities specifically tailored to the learning needs of the different groups.

**Virtual Reality**

The VR headsets often used in classrooms are made of plastic (e.g., Merge headset, shown in Figure 3) or cardboard (e.g., Google Cardboard, shown in Figure 4), which allow for a more affordable VR hardware options compared to more costly stand-alone, head-mounted devices. It should be noted that the durability of a plastic headset is significantly greater than cardboard, especially when used with younger students. Because only one third (8 to 10) of the students will be using the VR headsets at any time within a three-centers rotational model, classrooms that use blended learning in conjunction with VR headsets will only need to purchase one third of the typical number of devices (a complete classroom set). This strategy significantly reduces classroom technology costs.

Both plastic and cardboard headsets require the use of a portable device, such as a smartphone. Bring-your-own-device (BYOD) strategies can further reduce costs and offset the number of internet-connected devices a classroom would need to purchase since most students already have a device. For classrooms that cannot use personal devices, inexpensive smartphones can be purchased and programmed to only use on the school network. This can help to ensure that students cannot access unauthorized websites or apps.

An app often used in classrooms with plastic and cardboard headsets is YouTube VR. There are several 360° videos on its channel for each science discipline, and new videos are added on a regular basis. To access these resources, students click a link or do a quick search. Parent permission is required for children under the age of 13, and teachers should always preview content and supply students with links to maintain a positive learning environment. Teachers should consider the risks of cybersickness (motion sickness) and inform students that they can remove goggles, if needed. Additionally, students should stay seated while viewing VR videos and ensure there’s space to turn in their seats. In an independent digital rotational activity, students work independently on a task, such as navigating to a YouTube VR video, designing VR experiences in CoSpaces Edu or ThingLink, and watching their creation through a smartphone and VR headset.
work together in the cell?”). Students in the high group require teachers to advance learning by asking higher DOK questions (e.g., I asked, “If X in the cell were to be damaged, what would happen to Y?”). Each group learned the same content, but I facilitated instruction paced to each student’s individual learning needs. Other activities that I have used for this rotation include moderating discussions, reviewing assignments, and providing individual attention while students answer, reflect, and think.

Collaborative rotational activity
Collaboration is a useful strategy to have students ask questions, act as scaffolds for their peers’ learning, and teach each other. Within a collaborative activity, teachers can either have students discuss a science topic, build something together, co-author a presentation, or use a generative learning process (e.g., graphic organizer, summarize, drawing). This process allows students to find, arrange, and integrate information to gain a deeper understanding of a concept (Fiorella and Mayer 2016).

Figure 2 shows a group of students working together on a cell drawing and labeling activity, which was one of three tables (nine students) that collaborated simultaneously. Other activities for this rotation include collaborating to observe cells under the

---

**FIGURE 1:** Three centers rotational model (teacher-led, collaborative, and independent digital) including an introduction and closure.

**FIGURE 2:** Students collaborating on analyzing and answering questions.
INTEGRATING TECHNOLOGY

Independent digital rotational activity

This rotational activity allows for greater differentiation due to the vast possibilities of technology integration. Within this group, students can utilize technology for videos, gamification, online quizzing, simulations, online tutoring, or—in this example—VR.

Independent digital rotational activities present a logical opportunity to integrate VR to help increase students’ engagement and understanding of the topic. Students can enjoy science activities that they may not have the ability to see in real life due to the physical constraints of the classroom, safety concerns, or funding for laboratory equipment or field trips (Makransky, Petersen, and Klingenberg 2020). In this example, students learned about cells. Cells are difficult to understand due to their small size, so having a visual representation can help with comprehension. Figure 3 shows students using VR headsets for the YouTube VR video “Cellscape VR Biology Guided Tour for Kids” (Dewitt 2017). Students were engaged throughout the video and made comments such as “I’m in the nucleus!”

Each grouping that I created had slightly tailored assignments depending on contextual or learning needs. Students in the low group focused on Webb’s DOK 1 to focus on foundational understanding of definitions. I supplied these students with printed notes that had vocabulary and definitions. This helps to build their understanding of...
cells while also avoiding the confusion of complex vocabulary in the VR video. The mid group had a foundational understanding of vocabulary, so they focused on Webb’s DOK 2 to relate the vocabulary to the video. Students were supplied with a word bank that did not have definitions on it and were instructed to listen for the vocabulary to figure out how the organelle functioned. Last, the high group focused on Webb’s DOK 3 to extrapolate information from the video. Students were instructed to write a short prompt after the video to relate previous knowledge to the new information learned. Additional differentiation for all groups included self-pacing (pause, stop, rewind) and closed caption, which are automatically embedded into YouTube VR.

Conclusion
Combining technology and pedagogical strategies such as blended learning can improve students’ learning outcomes, engagement, and motivation toward science. Station rotations should be implemented into a science class once the teacher has established policies and procedures for collaborative work, digital work, and small groups. Teachers should situate themselves and the small group in an area that is visible to watch all groups during the rotations. Additionally, it is advised that the instructions for the rotational activities be available to students either on the board, through QR codes, or on a learning management system, so that students understand the expectations for the rotational activities. As teachers practice expectations and provide instructions, the blended learning model becomes a fluid addition to their classroom.

REFERENCES

ONLINE RESOURCES
Google Cardboard—https://tinyurl.com/25pm9s8f
Merge headset—https://mergeedu.com/headset
ThingLink—https://thinglink.com/edu
YouTube VR—https://tinyurl.com/4et2yk5h

Michael McKenzie [msmckenzi@coastal.edu] is a lecturer of instructional technology and Alex Fegely is an assistant professor and coordinator of instructional technology, both in the Spadoni College of Education and Social Sciences at Coastal Carolina University in Conway, South Carolina.