Obnoxious Obstacles…or Are They?

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6th-8th Grade, May be modified for other grades

Problem Context: How do obstacles placed in front of a wireless remote affect the movement of a TekBot?

I. Concepts Covered

Science

- ☺ Linear Motion
- ☺ Infrared waves and the Electromagnetic Spectrum
- ☺ Reflection
- ☺ Data collection/analysis
- ☺ Inquiry

Mathematics

- ☺ Measurement
- ☺ Graphing

II. Applicable Standards

Science

- ☺ Students will develop an understanding of science and technology.
- ☺ Students will develop the abilities necessary to do scientific inquiry.

Mathematics

- ☺ NCTM: Students will create and use representations to organize, record, and communicate mathematical ideas.

Technology

- ☺ Students will use technology tools to enhance learning, increase productivity, and promote creativity.

III. Learning Activity Context

Context: Moving TekBot

This lesson is intended to supplement and extend a lesson on types of electromagnetic waves and their uses in society. Students will use an infrared wireless remote to operate the TekBot. Once successful with basic maneuvers, students will place different obstacles in front of the remote to see if infrared waves can pass through different media; hence, continue to create TekBot movement. Their data will be recorded into a chart and reported later in the activity. In addition, students will use the materials to discover whether the infrared waves can reflect off the surface of the given media.

Anticipatory Set: Demonstrate moving the TekBot with the wireless remote.
Think-Ink-Share Activity— Think about how the TekBot "knows" to move when I push the remote? How does it receive that information? Think about wave motion. *Ink*—record your ideas in your science journal. *Share*—your ideas with your table partners and discuss.

Objective: Understand how different media affect infrared light waves.

Procedure:

- ☺ Discuss "Before Activity" questions as a class
- ☺ Distribute and review expectations of the lab sheet and answer any questions
- ☺ Divide students into groups of 3-4 and assign roles (see Teacher Suggestions)
- ☺ Have materials available in totes for students to use—1 sheet of notebook paper, 1 sheet of black construction paper, 1 notebook, mirror, glass (tape the edges)
- ☺ Monitor groups as they progress through the lab exercise—answer questions and encourage groups to explain why they are getting certain results; experiment with other materials; reflect on their learning

Closure:

- ☺ See "After Activity" Questions
- ☺ Students finish their lab report with reflections before the next class period

IV. Teacher/Student Suggestions

- ☺ Use cooperative learning groups and assign roles to each student in the group: Principle Investigator (asks group questions of teacher, leads group), Materials Manager (gathers materials and returns them), Timekeeper (monitors time and group progress), and Reporter (Reports results to the class). Everyone participates! However, each student is responsible for collecting and recording the data from the activity on his/her own lab sheet.
- ☺ During the activity, it works well to have 1 person operating the remote, 1 person holding the obstacle in front of the remote, 1 person measuring distance between the remote and TekBot initially, and 1 person recording.

V. Teacher Questions

Before Activity:

- ☺ How do infrared waves travel from the remote to the TekBot? *A disturbance is created when waves travel through air; hence, energy is transferred and received by the sensor on the TekBot.*
- ☺ What would happen to TekBot movement if an obstacle is placed between the remote and the TekBot? *Brainstorm ideas and reinforce content learned up to this point—do not reveal answer; instead explain that they will investigate to find out!*
- ☺ Can infrared waves reflect off a surface and travel to the TekBot's sensor? *Discuss possible answers and reinforce that they will be investigating this question.*

During Activity:

- ☺ Monitor student progress and encourage the students to try using the wireless remote at different distances and using other obstacles to make inferences/generalizations about infrared waves and different media.

After Activity:

- ☺ Was the wireless remote effective in transmitting a signal through all of the media? Why or why not?
- ☺ If the wireless signal was received and the TekBot moved, what can you infer about the material of the obstacle? Use your knowledge of electromagnetic waves to defend your response.
- ☺ Were there any materials that the infrared waves could not pass through that reflected infrared waves? Why did that occur?
- ☺ Did you notice a change in speed or sound produced by the TekBot while using the wireless remote?

VI. Assessment Ideas

Assessment for student learning could occur through the use of completed lab report and informal observations throughout the lesson. In addition, students could demonstrate understanding of these concepts using a television and infrared remote as a performance assessment—predict whether the material will allow a signal to travel to the television. Explain your prediction and complete the activity.

VII. Other Information

Extensions to the lesson could include mounting a laser pointer to the TekBot. Using the laser pointer, students would manipulate mirrors to "hit" a designated target. This would further enhance students' exploration of reflection of light waves.

Students could also investigate and research other sensors that are used in daily life, aside from infrared sensors in remotes. They could apply their learning from what they did with the TekBot to their own television set at home. This may serve as a good opportunity to collaborate with parents (see Additional Links).

If you have students who are proficient or beyond proficient in the learning objectives of this lesson, they could conduct independent research—a topic that may appeal to them would be researching how the "Wii" controller works and other video game devices that are tethered to a central location.

If working with younger students, you may want to review the materials box and reinforce vocabulary: translucent, opaque, or transparent using materials such as tissue paper, glass, and an overhead sheet.

VIII. Materials Needed

- ☺ 1 TekBot per group with wireless remote capabilities
- ☺ 1 Materials Tote per group including: 1 sheet of notebook paper, 1 sheet of black construction paper, 1 notebook, mirror, glass (tape the edges)
- ☺ Student Lab Sheets (1 per student)

IX. Student Templates or Worksheets

1. Hypothesis: I predict that the infrared remote's signal will travel through _____ because _____.

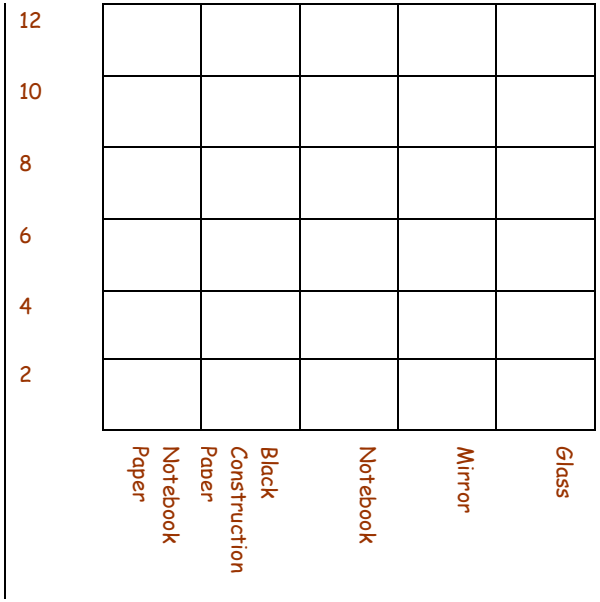
2. Prediction: Will the distance between the wireless remote and the obstacle change your results? Explain your reasoning.

3. Conduct your experiment. Complete the chart below as you test each material.

Material	**Prediction—What will happen when this material is placed in front of the remote?**	**Distance—How far away is the infrared remote from the obstacle? Record in centimeters (cm)**	**Results—What happened? What did you hear? Did the TekBot move?**	**Reflection—Why did you observe these results? What new questions do you have?**
Notebook paper				
Black construction paper				
Notebook				

Mirror				
Glass				

4. Graph the distance between the remote and the "obstacles."
Label your graph: Title, X-axis, Y-axis



Student Worksheets/Templates (Continued)

Expected Results

Material	**Prediction—What will happen when this material is placed in front of the remote?**	**Distance—How far away is the infrared remote from the obstacle? Record in centimeters (cm)**	**Results—What happened? What did you hear? Did the TekBot move?**	**Reflection—Why did you observe these results? What new questions do you have?**
Notebook paper	*The TekBot will move because (students will need to use learning from the unit to "defend" their prediction with scientific facts/knowledge. OR The TekBot will not move because…*	*Will vary depending on group—any more than 18 cm becomes difficult to observe results.*	*Students are expected to use science reasoning skills such as inferring, predicting, measuring, and hypothesizing to describe their results. They may need to repeat the exercise several times to record accurate and well-thought-out information.*	*For each material, students should have an accurate explanation for why they observed the results that they did. The goal is to make connections between the types of materials and the results they observed—for example, is there a connection between color of the material and whether the infrared light wave was sensed by the TekBot?* *As an extension, students could be given a hypothetical situation and think about whether the signal would be received.*
Black construction paper				
Notebook				
Mirror				

Glass				

IX. Additional Links

☺ http://electronics.howstuffworks.com/remote-control2.htm

"How Stuff Works" explaining how infrared remote controls work and their application in everyday life

☺ http://www.reachoutmichigan.org/funexperiments/agesubject/lessons/newton/infrared.html#TRY

An extension activity related to television remotes. This basically extends this activity through using a TV remote

More links will be added throughout the year…