Title of Lesson Plan	Displaying Artwork with Magnets
Objective	Students will experiment with and observe how the thickness of a material being hung by a magnet effects the strength of the system.
Standards	*National:* *3-5-ETS1-3 Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.* *Georgia:* *S5P3b Plan and carry out an investigation to observe the interaction between a magnetic field and a magnetic object.*
Grade Level	5th Grade
Pacing	3 sessions, can be cut to 2 sessions if teacher or students do prep work outside of class time.
Guiding Questions	What are some ways magnets are commonly used? How would you expect the size of the magnet affect the amount of weight it can hold? How would the thickness of the object affect the amount of weight the magnet can hold?
Collection Connection	Dulemola textile (2003.040.202) Image of the Ancient City, copper engraving (2007.035.001A/L) Female effigy spout and bridge ceramic vessel (1989.008.132)
Content (About the Artwork and/or connection to the topic)	**What are some ways magnets are used in museums?** Magnets are used in art conservation to display objects without having to pin through them, and to hold pieces of an object together when it is being repaired. In both cases, the attraction of the magnet to the ferromagnetic surface behind it has to be sufficient to hold the weight of the object, but not so strong as to deform the object. A ferromagnetic material is one which attracts magnets, such as iron, other magnets, and some types of steel. How much weight a magnet can hold depends on a variety of factors, the most important of which are the type and size of magnet, the surface it is being attracted to, and the distance between the surface and the magnet. **How would you expect the size of the magnet affect the amount of weight it can hold?** **How would the thickness of the object affect the amount of weight the magnet can hold?**

	Many factors other than the distance between the paper packet and the magnet affect the amount of weight that the magnet will carry. The most important is the ferromagnetic surface: how thick it is, what metal it is made of, its texture, and if it is painted. With less magnetically attractive surfaces, you may not be able to hold the 16 sheet packet. The type and size of the magnet will also affect the amount of weight it can hold as well as which packet thickness it can hold.
Project Title	*Displaying Artwork with Magnets*
Materials	Balloons (Party store variety pack with different colors) Rice (beans or lead shot also work, whatever is most accessible) Funnel Scale (Should measure up to 300 lbs and measure to at least the tenth place) Zip ties Sharpie permanent markers Binder clips Paper clips 5 sheets of paper Magnets (neodymium encased in plastic; "push pin" magnets) Ferromagnetic surface (whiteboard, metal cabinets, metal doors) Scissors Ruler Calipers
Instructions	Week 1 - The teacher will introduce the concept of magnet use in museums and ferromagnetic surface through Classroom Presentation. Include context and cultural relevance. - The class will discuss and investigate ferromagnetic surfaces in the classroom as well as measuring the strength of magnets. - The teacher will introduce the experimental set up and have students prepare weighted bags and paper packets. Students will weigh and measure the thickness of each paper packet. (If the teacher does not have sensitive enough balances for this, a cut up piece of cardboard can be used to demonstrate that the packets will all be the same weight). Students will record all of this information in their worksheet. Week 2 - The teacher will reintroduce the concept of ferromagnetism and guide students through the magnetic systems

	experiment. Students will choose different ferromagnetic surfaces in the classroom (make sure there are duplicates) but use the same type of magnet. - Students will then graph their data on their worksheets and choose which graph type is most similar to their data. - The teacher will conclude the class with a brief discussion of how the thickness effects the strength of the magnetic system. Week 3 - The teacher will have students compare their different ferromagnetic surfaces by having each group graph their data on a class graph. They will lead a class discussion about the strength of different systems. - The teach will then discuss types of mechanical strength and their applications in conservation research through PowerPoint presentation with examples of test setups used by conservators and scientists. - Students will see the connection between their experiment and the types of experiments used in the field of cultural heritage.
Assessment	See attached worksheet
Additional Resources (Bibliography, other artwork in the collection, FAQs, books/websites for the classroom, etc.)	VanCleave, Janice. *"Janice VanCleave's Magnets: Mind-boggling Experiments You Can Turn Into Science Fair Projects."* Spangler, Steve. *"Smithsonian 10-Minute Science Experiments: 50+ quick, easy and awesome projects for kids."* Magnetic poetry kits (tie in literacy) What Makes a Magnet? By Franklyn M. Branley, 1996 Magnets Push, Magnets Pull by David A. Adler, 2017 Magnet Max by Monica Lozano Hughes, 2015 A Look at Magnets by Barbara Alpert, 2011 Magnetic and Nonmagnetic by Angela Royston, 2003 What Magnets Can Do by Allan Fowler, 1995 Magnets Pulling Together, Pulling Apart by Mandy Ross, 2002

	All About Magnetism by Angela Royston, 2016 What are Magnets? A Child's Guide to Understanding Magnets-Science Book for Elementary Schools, Children's How Things Work Books (Baby Professor, 2017) The Science Book of Magnets by Neil Ardley, 1991
Handouts/Worksheets	See attached worksheet
Vocabulary	Ferromagnetic, shear strength, tensile strength, compressive strength, magnetic system.