Research & Innovation Brief

TEXAS A&M UNIVERSITY
Education Leadership Research Center

TEXAS A&M UNIVERSITY
Center for Research & Development in Dual Language & Literacy Acquisition

Family Involvement in Science (FIS): An Overview of the Practice

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Overview

Family Involvement in Science (FIS-- pronounced fizz; Irby, Lara-Alecio, & Tong, 2010) *has as its intent to* improve family engagement with their children in the area of we have named as literacy-infused science. This is achieved through Bronfenbrenner's (1979) foundational work in his ecological model that seeks to interconnect the home, school, and classroom learning environments of children in early grades (K-3), and we have extended that up to grade 6. Additionally, it is a child-centered and family-supporting approach that builds and promotes the strengths that families already have, and it assumes that families are strengthened and that development is enhanced through helping relationships and partnerships which include a connection to the community.

FIS is designed to develop critical components that integrate home, school, and classroom learning environments (Home- via family engagement; School- via PD with preservice and in-service teachers and principals; family engagement activities with the reading (literacy), science, and English language proficiency standards of Texas). We include science as the center of literacy, because science is all around in everyone's day, regardless of the economic level or the spoken language. Science – every day—is the connector of every culture. The at-home science activities will take the name of FIS (Irby, Lara-Alecio, & Tong, 2010). Family includes not only a parent or parent(s), it can include caregivers, aunts, uncles, grandparents, cousins, siblings, or extend family members. Ferlazzo (2011) indicated that engagement was more aligned to what educators should be aiming for in schools. He indicated, "involvement implies *doing to*; in contrast, engagement implies *doing with*" (para. 4). We use both terms. While we do want the families to engage with their children at home in the science activities, and we advocate that before they can be engaged, they must be invited to be *involved*. In FIS, they share with their children specific activities that we prepare with guidance, so in this manner, this *is* Involvement, but as the parents work with their children on the activities, they *become* engaged. So, we believe in this sense, FIS is Family *Involvement* in Science that leads to full engagement with their children.

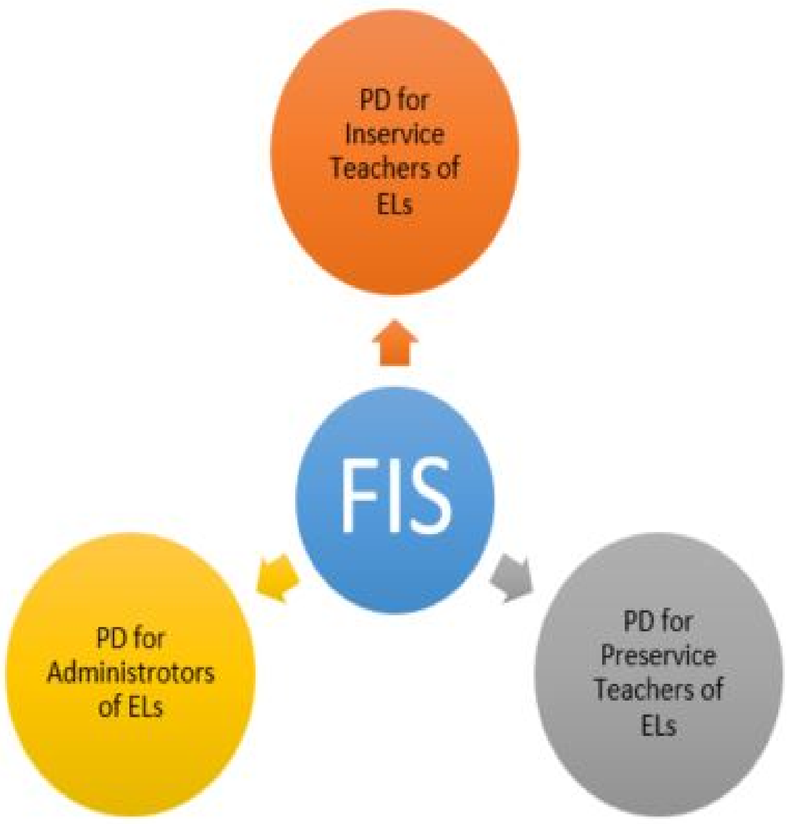
Observations of FIS

We could find no published attempts to *use technology to observe a dyadic activity* as families engage in such science activities together at home. Providence Talks is a project that intervenes early and is testing a word pedometer developed by the Lena Foundation to infuse words to support less affluent children prior to their coming to kindergarten. This technology develops a comprehensive picture of a child's daily auditory environment, including adult word count and the number of conversational interactions the child engages in during the course of the day. Through FIS we will be able to check similar academic vocabulary and comprehension for the number of strategically standards-aligned family engagement science activities. These interactions and engagements will be gauged by a researcher-developed rubric via observations taken by a robot and iPad within the home and recorded two 20-minute time periods weekly. Practice science engagement apps for the iPad will be developed and tested to be used for 4 days per week in the home. So with FIS, our research team has engaged in a practice that according to literature, has never been done before—***we have gone into the home via technology*** to observe the family/parent engagement/involvement with children as they work together on FIS. All work has had the intent in an informal learning environment to aid the children in improving their literacy skills of vocabulary (general and science), big ideas in science, and their reading comprehension skills.

Professional Development Relationship

In order to develop FIS, we have worked with Professional Development (PD) with three groups: (a) preservice teachers, (b) in-service teachers, and (c) administrators (all of K-3 grade levels), see Figure 1. Additionally, we will engage undergraduate technology management students to develop the apps. The PD for preservice teachers has included how to engage families and community partners for the improvement of achievement for English learners, how to develop literacy-infused science for English learners, and how to develop FIS components of FIS (how to improve literacy, academic language of science, big ideas of science, and reading comprehension). The PD for in-service teachers of English learners has included how to engage families and community partners for the improvement of achievement for English learners, how to develop literacy-infused science for English learners, and how to train family members to work at home with their children on FIS). The PD for administrators of campuses that serve English learners has included how to promote critical dialogues with their teachers and parents to improve culture in their schools, how to provide better support for teachers who are working to engage families in FIS, and how to develop literacy-infused science for English learners. Rearchers have demonstrated that parent and/or family involvement skews heavily towards reading and mathematics; however, many parent involvement studies do not specifically address science (Rodriguez, Collins-Parks, & Garza, 2013).

Figure 1
FIS Professional Development



Science engagement among families contributes to fostering a science identity, improving scientific reasoning, cultivating scientific practices, increasing interest in science, and strengthening conceptual understandings of phenomenae (Bricker & Bell, 2014; Zimmerman, 2012; Crowley, Callanan, Tenenbaum, & Allen, 2001; Crowley & Jacobs, 2002; Gonzalez, Moll, & Amanti, 2006; Vedder-Weiss, 2017; NRC, 2009; Pattison, 2014; Fender & Crowley, 2007). Further, student confidence and achievement increase exponentially as the level of family engagement in a child's experiences with science increases (Barnard, 2004; Callanan et al., 1995; Cotton & Wikelund, 2001; Crowley et al., 2001; Hill & Tyson, 2009). Specifically, we have been engaged in Literacy-Infused Science Using Technology Innovation Opportunities, a 5 year, $12 million federally-funded program investigating effective science instruction in Texas with districts with minimum 50.1% economically challenged (EC) students, 66% rural campuses. Our LISTO Mission has been to improve students' science and reading/writing literacy achievement by working with teachers, administrators, and families. Figure 2 demonstrates how FIS is used in the homes.

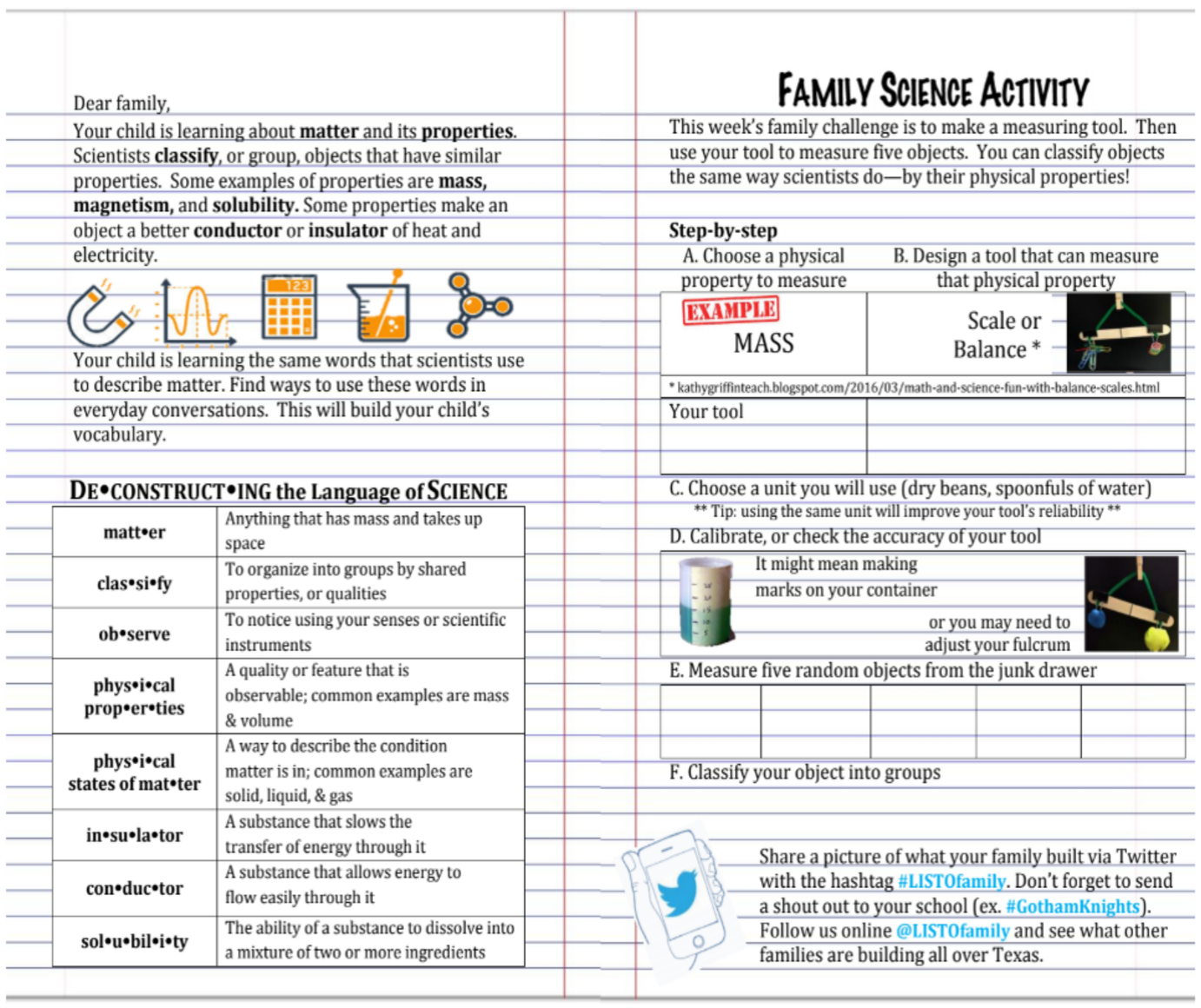
Figure 2
FIS Implemented With Go-Vision Goggles

FIS Components

FIS booklets include strategic opportunities for families to "Do Science" together. These opportunities are aligned, inquiry-based, include embedded literacy, allow for flexible participation, designed to take 10-15 minutes, and utilize no-cost/low-cost materials. FIS booklets include the following components, and are available in both English and Spanish:

- **Dear Family Letter** introduces the science topic and related academic vocabulary starts with a short letter directed to the student's family, Figure 3;
- **Science academic vocabulary** is introduced with a syllable breakdown to help in decoding and a student-friendly definition;
- **Family Science Activity** provides an opportunity to families to explore the concept with no-cost/low-cost items typically found in homes
- **Reading Passage** provides related science text for families to read, discuss, and interact with, see Figure 4;
- **Extension** science activities and related science literature are provided on the back cover, see Figure 5.

Figure 3
FIS Booklet: Dear Family, Vocabulary, and Family Science Activity



Dear family,

Your child is learning about **matter** and its **properties**. Scientists **classify**, or group, objects that have similar properties. Some examples of properties are **mass, magnetism,** and **solubility.** Some properties make an object a better **conductor** or **insulator** of heat and electricity.

Your child is learning the same words that scientists use to describe matter. Find ways to use these words in everyday conversations. This will build your child's vocabulary.

DE•CONSTRUCT•ING the Language of SCIENCE

matt•er	Anything that has mass and takes up space
clas•si•fy	To organize into groups by shared properties, or qualities
ob•serve	To notice using your senses or scientific instruments
phys•i•cal prop•er•ties	A quality or feature that is observable; common examples are mass & volume
phys•i•cal states of mat•ter	A way to describe the condition matter is in; common examples are solid, liquid, & gas
in•su•la•tor	A substance that slows the transfer of energy through it
con•duc•tor	A substance that allows energy to flow easily through it
sol•u•bil•i•ty	The ability of a substance to dissolve into a mixture of two or more ingredients

FAMILY SCIENCE ACTIVITY

This week's family challenge is to make a measuring tool. Then use your tool to measure five objects. You can classify objects the same way scientists do—by their physical properties!

Step-by-step

A. Choose a physical property to measure	B. Design a tool that can measure that physical property
EXAMPLE MASS	Scale or Balance *

* kathygriffinteach.blogspot.com/2016/03/math-and-science-fun-with-balance-scales.html

Your tool

C. Choose a unit you will use (dry beans, spoonfuls of water)

** Tip: using the same unit will improve your tool's reliability **

D. Calibrate, or check the accuracy of your tool

It might mean making marks on your container

or you may need to adjust your fulcrum

E. Measure five random objects from the junk drawer

F. Classify your object into groups

Share a picture of what your family built via Twitter with the hashtag #LISTOfamily. Don't forget to send a shout out to your school (ex. #GothamKnights). Follow us online @LISTOfamily and see what other families are building all over Texas.

Figure 4
FIS Booklet:Reading Passage

Title: _____

Instructions: Create a title for the reading passage below

Everything in our physical world is made of **matter**. We **observe** and **describe** matter using **physical properties**. When we use matter, we think about it in different ways. If we are making a sandwich, we think about different combinations of flavors. We can combine different flavors to make the best tasting sandwich. If we are choosing out outfit in the morning, we think about how the different pieces of clothing look. If we are playing basketball, we think about where the ball is going and how we can control it.

In the case of the basketball, scientists might think about properties like its appearance (round, knobby texture, orange color), **buoyancy** (Does it float? Yes.), or **conductivity** (no, it can't carry an electrical current).

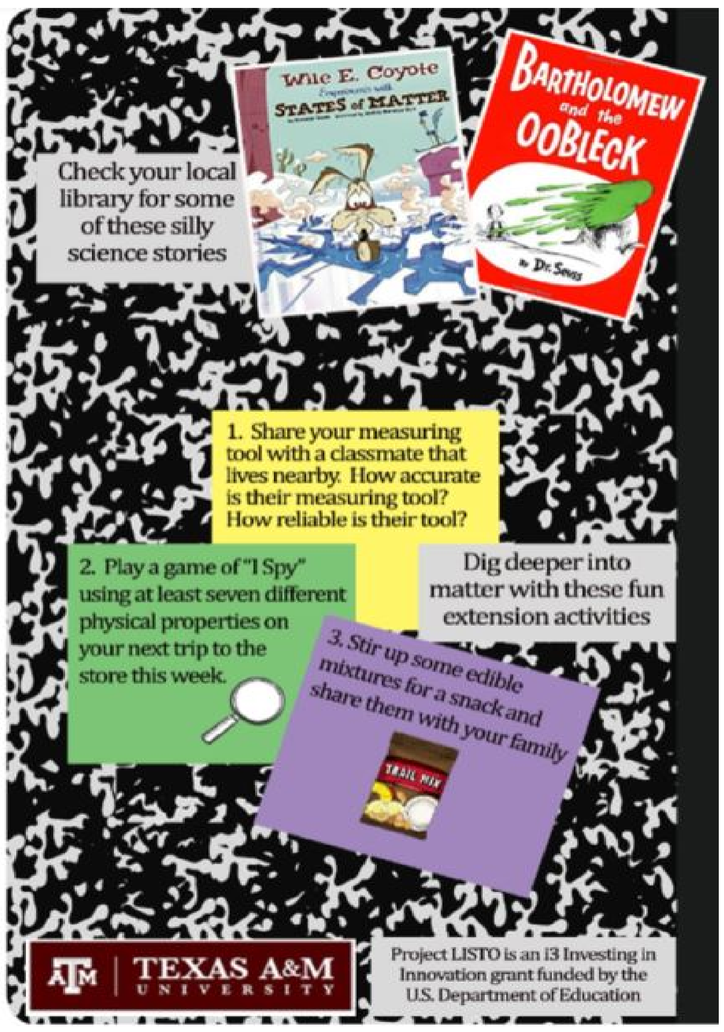
Some other physical properties are **boiling point, density, ductility, hardness, magnetism, malleability, mass, melting point,** and **odor**. Some physical properties we can test using our five senses. Other properties need specific scientific tools.

Instructions: Draw a physical property

We can change some of the physical properties of matter. For example, we can take a big block of cheddar cheese and chop it into tiny pieces. That changes the cheese's size and shape, but not its color. You won't be able to pick the pieces of cheese up with a magnet or use it to scratch glass, like a diamond. Also, the pieces of the cheese will still have the same mass as the original block of cheddar. Put it on some nachos and have a snack.

How do you use **physical properties** to make choices as a family?

Figure 5
FIS Booklet: Extensions



Check your local library for some of these silly science stories

Wile E. Coyote Experiment with STATES of MATTER

BARTHOLOMEW and the OOBLECK by Dr. Seuss

1. Share your measuring tool with a classmate that lives nearby. How accurate is their measuring tool? How reliable is their tool?

2. Play a game of "I Spy" using at least seven different physical properties on your next trip to the store this week.

3. Stir up some edible mixtures for a snack and share them with your family

Dig deeper into matter with these fun extension activities

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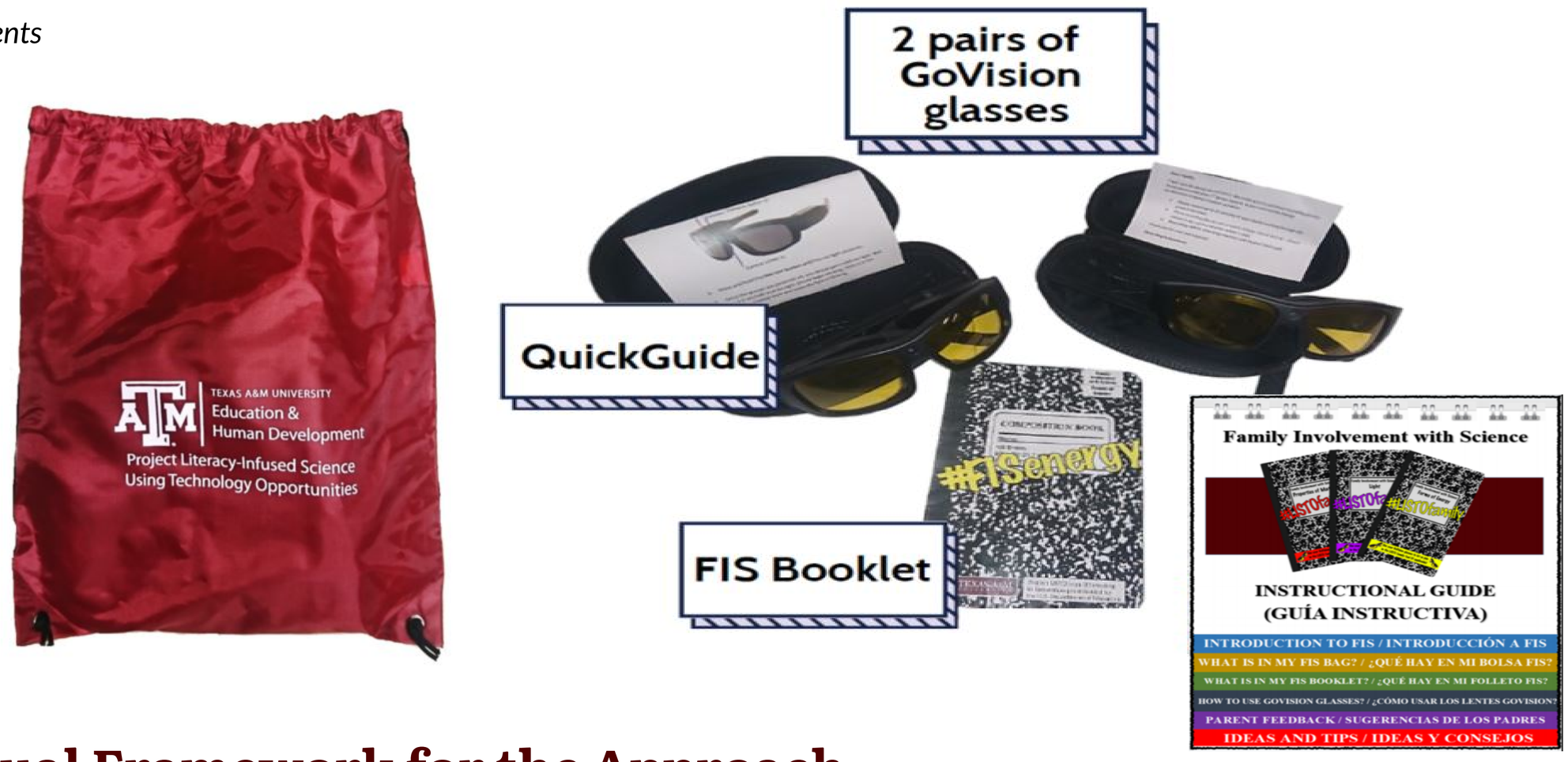
Project LISTO is an i3 Investing in Innovation grant funded by the U.S. Department of Education

Figure 6
FIS Kit Components



Conceptual Framework for the Approach

Estimates place the EL population at over 5 million in the United States in 2017, which was 10.1% of all students nationwide, grades pre-K through 12 (National Center for Education Statistics (NCES, 2020). In the State of Texas in 2019-2020 school year, there were 1,061,614 ELs, or 19.5% of the school population. By the time ELs reach eighth grade, the National Assessment of Educational Progress (NAEP 2009) shows that only 3% achieved at or above proficient level, in comparison to a 35% of native English speaking students (NCES, 2010), and in general, the NAEP average reading score for ELs in 2013 was not significantly different from 2015 (The Nations Report Card, 2015). Furthermore, researchers also have indicated that by the time children who are economically disadvantaged who enter kindergarten, do so with an average vocabulary level of 5,000 words; while children from middle and upper-middle socio-economic families enter school with a vocabulary of 21,000 words on average (Snowman, McCown, & Biehler, 2009). According to Providence Talks (2014), children need to hear about 21,000 words daily for their vocabularies to develop at an appropriate pace; children growing up in less affluent homes hear significantly fewer words each day than their peers in middle and high-income households. Children in homes where English is not spoken often lack exposure to critical oral language skills such as English vocabulary, grammar, pragmatics, and discourse. Without these skills being modeled and reinforced in the home, these students enter school already significantly behind their peers (Biemiller, 1998). These statistics and information point to the importance of programmatic interventions at the home learning environment in ways that are meaningfully and relevant interconnected with the school and classroom environments.

Researchers have indicated leveraging academic improvement for successful early childhood learning environments includes the integration of the home with classroom environments (Downey, 2008; Haertel, Walberg, & Haertel, 1981; Masten et al., 2008; Henderson et al., 2007; Rivera, 2008, 2014; Waxman & Huang, 1996). Though Epstein (1987) suggested data had not been particularly forthcoming in the 1980s on the impact of parent/family involvement, a meta-analysis of the literature on parent engagement was conducted by Jeynes in 2005 and the findings pointed to the impact of engaging parents and/or families in their children's education. Jeynes found that there are four types of program characteristics that have a statistically significant positive effect (Effect Sizes) on children's academic achievement. They include: (a) shared reading (.51), (b) teacher-parent partnership (.35), (c) checking homework (.27) and (d) teacher-parent communication (.28). For example, the effect size of programs that encourage parent/child to share reading at home is .51 of a standard deviation, which equates to about .60-.65 of a grade point. When parents participate in academic activities with their children, this engagement demonstrates an equivalent of 4 to 5 months improvement in reading or math performance (Jeynes, 2005). Specifically, parental behaviors that support high achievement of low-income Hispanic/Latino students were found to be the following (a) high expectations, (b) sets high expectations in the completion of school, (c) connects education with success, (d) expresses desire and acts to further their own education, (e) saves money for children's education, and (f) acts as a role model in acquiring an education (Lara-Alecio, Irby, & Ebener, 1997). Furthermore, with economically disadvantaged parents of three ethnic groups (European American, African American, and Hispanic/Latino), it is important to engage such parents in dialogue with a free flow of ideas, and those parents should be engaged not only with their children's home supportive education but also in systemic school reform. Engaging families breed positive feelings toward teachers and school and thus is supportive of the children (Parker, Lara-Alecio, Ochoa, Bigger, Hasbrouck, & Parker, 1996). Three of the PIs in this paper, have had a successful National Science Foundation grant (Project MSSELL, DRL-0822343) at the elementary level that included a family involvement component which was called FIS, and they had an Institute of Education Sciences grant that also had a family involvement component at the Kindergarten level (Project ELLA, R305P030032). Both studies were evaluated and now are included in the What Works Clearinghouse.

The Department of Education's 2006-2007 "Parent and Family Involvement in Education" survey found that just 55% of parents were "very satisfied with the way school staff interacts with parents" (Herrold & O'Donnell, 2008). Though there have been some successful programs reported with technology included such as The Committee for Hispanic Children and Families @ PS/MS 279 in New York, there was *no program that we could find that included our types of FIS approach of PD that promotes the infusion and use of technology* for apps, websites, webinars, and in-home observations in family engagement (FIS). The novelty of the approach with family engagement is that this, with the assistance of technology, is *the first time* to be able to *go into the home* and observe virtually the parent/family engagement dyads at appointed times only using the take-home materials developed. This approach included go-vision recording glasses. Here, we were able to monitor time, the vocabulary used, the language of communication, the amount of time oral language which was used by the family member and the child, the academic vocabulary usage, and the number of low and high-frequency words used in the specific language of communication. An observation protocol has been developed to take those data, see Figure 7.

Figure 7
Family Involvement in Science Observation Protocol

Time	FIS Component	Physical Group	Strategy Family Member / Student		Activity Structure Family Member / Student		Communication Mode Family Member / Student		Language Family Member / Student		Language Content Family Member/Student		Focus/Gaze Family Member / Student		Science Learning Behaviors Family Member / Student		Science Academic Vocabulary Family Member / Student		Alternative Conceptions Family Member / Student	
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CODING	1 Dear Family	1 Father/Adult	50 NA	50 NA	1 lec/lis	1 lec/lis	1 writing	1 writing	1 Other	1 Other	1 social	1 social	1 materials	1 materials	1 ref prior knwl	1 ref prior knwl				
	2 Vocabulary	2 Mother/Adult	51 LQ	51 LQ	2 lec/per	2 lec/per	2 reading	2 reading	2 Eng	2 Eng	2 routine	2 routine	2 booklet	2 booklet	2 obs/measure	2 obs/measure				
	3 Rdg Passage	3 Older Child	52 CO	52 CO	3 dir/lis	3 dir/lis	3 aural	3 aural	3 Other-Eng	3 Other-Eng	3 light cog	3 light cog	3 participants	3 participants	3 ask questions	3 ask questions				
	4 Sci Activity	4 Younger Child	53 CF	53 CF	4 dir/per	4 dir/per	4 verbal	4 verbal	4 Eng-Other	4 Eng-Other	4 dns cog	4 dns cog	4 spectators	4 spectators	4 predict	4 predict				
	5 Ext Activity	5 Grandparent	54 ALS	54 ALS	5 dem/lis	5 dem/lis	5 wr-re	5 wr-re	5 NA	5 NA			5 other	5 other	5 model/demo	5 model/demo				

Improved Outcomes

FIS can substantially improve on the outcomes achieved by traditional PD practices by working with families of ELs and economically challenged students which results in better student outcomes. Because the majority of the activities will be delivered through Apps, webpage, and webinars, FIS will allow engagement in its content without excessive cost for travel, additional teacher pay, consultants, or excessive printed materials. Teacher participation in FIS should positively impact families' involvement and ultimately the academic language of the students, science understanding of the students, and literacy skills (academic vocabulary, oral language, reading fluency, and comprehension) of the students. An unanticipated effect we expect is that the families will become a type of citizen scientist having worked with their children on Family Involvement in Science (FIS) at home weekly for 16 weeks in Kindergarten and 25 weeks in first, second, and third grades (over a 4-year time period). We anticipate that family engagement will also impact the rural ELs' and economically challenged students' and their families' proclivity for college and careers. We conducted a survey with participating family members during the 2019-2020 school year to learn more about the family perspective of FIS as related to ease of use and impacts of participating in FIS, see Table 1. Overwhelmingly, families reported positive perceptions of the FIS activities and shared that participating in FIS increased science conversations in the home, and improved student attitudes towards science.

Table 1
FIS Family Survey Results

Survey Question	Strongly Agree	Agree	Not Sure	Disagree	Strongly Disagree
It was fun to do science with my _____ (family member). (n=167)	104	60	2	1	0
The instructions for the science activity were easy to follow. (n=151)	61	71	11	5	3
The activities in the FIS kit didn't take too long (n=150)	68	68	10	3	1
It was easy to use the science vocabulary during the activities (n=150)	58	75	11	5	1
I could easily find the materials needed to complete the activities (n=149)	68	62	14	3	2
This has encouraged me to have more science conversations at home (n=16)	5	9	2	0	0
We will look for the suggested books at our library or bookstore. (n=15)	5	4	6	0	0
We will do the extension activities presented on the back of the FIS booklet (n=15)	5	5	4	1	0
My learner's attitude toward science improved with the use of the FIS booklets. (n=15)	6	9	0	0	0

Note. Survey responses for questions included in Spring 2020 surveys were limited due to COVID-19.

Further, when asked to share about their experience with the FIS booklet and how FIS activities changed science attitudes, participating family members shared the following:

- *"It shows how the experiences are connected to real life."*
- "*Cosas no saben nuestros padres pero nosotros los ayudamos con lo que sabemos"* (Things our parents don't know but we help them with what we know).
- *"Mucho la familia esta aprendiendo ciencia y el tiempo"* (A lot, the family is learning science and the weather).
- *"Si nos gusta hacer los proyectos porque lo hace toda la familia" (We do like working through the projects because all the family participates).*
- *"It encouraged my daughter to appreciate science and have fun learning."*
- *"It was very easy to use and easy to understand."*
- *"It was interactive and very engaging and many people will be more willing to participate in it instead of just doing a worksheet."*

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