Science of Spin ™
and the TEKS Objectives

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The Science of Spin ™ program is an interdisciplinary program between science and physical education. Math, Language Arts, Social Studies, and additional Science are also incorporated into the Interdisciplinary Curriculum provided to the school. This writing summarizes how the Science of Spin ™ program supports the Texas Essential Knowledge and Skills science objectives.

Format of this document

Page 1-2 identifies the Science concept that are addressed as part of the Science of Spin ™ presentation and curriculum.

Pages 3-5 discusses in detail how these concepts are addressed in the Science of Spin ™.

Pages 6-10 identifies specific TEKS statements of science objectives by grade level and explains again how the Science of Spin™ addresses these concepts.

Page 11 identifies the TEKS science objectives for grades 6 and 7.

Page 12 identifies the benefits of the Physical Education component of the Science of Spin ™ program, and can be incorporated into the TEKS objectives for P.E.

NOTE: Keep in mind that a few of these concepts, though not specifically named in the TEKS Objectives are contained in the science textbooks and taught in the classroom in order to be built upon in mastering the TEKS Objectives.

SCIENCE

Introduction

TEKS Science objectives for grades 1-7 identify increasingly complex concepts of science. The Science of Spin ™ assembly program is designed to primarily support science concepts in the area of physics, particularly in the area of force and motion. While the assembly presentation is geared for students in grades 3 and up, the Science of Spin ™ Interdisciplinary Curriculum, given to the school as part of the program, addresses all grade levels appropriately and continues to support not only physics, but also scientific processes such as the Scientific Method.

TEKS Objective 3 states: “The student will demonstrate an understanding of the physical sciences. The physical sciences explain the overall structure and the basic physical principles of the universe, with an emphasis on **matter, energy, motion and forces.”** The Science of Spin ™ presentation addresses the following physical science concepts:

During Science of Spin Presentation:

1. Gyroscopic Stability – (Newton's Laws of Motion)
2. Distribution of Mass
3. Rotational Inertia (Spinning Energy)
4. Planes of Spin – vertical, horizontal, diagonal
5. Friction – force which causes change
6. Air Resistance (drag)
7. Levers – effect on energy production
8. Gravity – natural force that causes motion
9. Potential & Kinetic Energy – transfer of energy

Additions included in Interdisciplinary Curriculum / Products

10. Scientific Method
11. Simple Systems
12. Electricity – flows in a circuit and can produce light

Summary of TEKS Objectives Addressed Grades 1-5

1. Gyroscopic Stability – Newton's Law of Motion. This concept is addressed beginning in Grade 3 TEKS. The students are to observe the direction and position of objects as they are affected by a force. Grade 4 TEKS specifically expects students to understand that "certain characteristics of an object remain constant even when the object is rotated like a spinning top…"

The Science of Spin ™ Presentation addresses this area of Force and Motion throughout the program in the following manner:

- Once a wheel is spinning in a particular plane (review of horizontal, vertical and diagonal planes of spin), it does not want to change its plane of spin, as long as it has Rotational Inertia (Concept 3) (or spinning energy). This concept is continually repeated throughout the program using objects such as a wheel, a gyroscope, a yo-yo, a spin top, and a football.

2. Distribution of Mass. Although not specifically found in TEKS, this concept relates for Force and Motion, which is addressed beginning in Grade 3.

The Science of Spin ™ Presentation addresses Distribution of Mass throughout the program in the following manner:

- When two or more objects are spun or thrown while spinning, each with the same velocity of spin, the object having the greatest percentage of mass on the outside rim will spin the longest or travel the furthest. This concept is visually reinforced with demonstrations with flying discs, spin tops and footballs.

3. Rotational Inertia (Spinning Energy). See concept 1. Gyroscopic Stability.

4. Planes of Spin. Although not specifically found in TEKS, planes of spin are also studied during Force and Motion as well as in Mathematics.

The Science of Spin ™ Presentation addresses Planes of Spin when demonsrtating with the wheel in concept 1 – Gyroscopic Stability. Students are expected to respond to the presenter in answering what plane a particular object is spinning in. (wheel and spin top)

5. Friction. This concept is addressed beginning in Grade 1 TEKS. The students are introduced to friction being an example of something that causes change.

The Science of Spin ™ Presentation addresses Friction throughout the program in the following manner:

- Describing why a wheel, yo-yo or spin top eventually stops and falls over. A discussion ensues regarding where the friction exists in

each of these examples (ground, air, hand, and string). Air Friction (air resistance) is most specifically discussed as it relates to flying discs.

6. Air Resistance (Drag). See concept 5. Friction.

7. Levers. Although not specifically found in TEKS, pulleys and levers are discussed in science textbooks beginning in Grades 4 & 5.
The Science of Spin ™ Presentation addresses Levers in the following manner:

- Description that the finger, hand, forearm and entire arm all are levers. To throw a yo-yo most forcefully requires the longest lever available, the entire arm. Yo-yos that are thrown with the wrist generate less spin time.

- A diabolo is used to demonstrate the use of levers to generate power, to transfer energy, and to throw the diabolo into the air.

8. Gravity. This concept certainly begins in Grade 1 but is addressed specifically beginning in Grade 3 TEKS as describing examples of change caused by a force, such as gravity.
The Science of Spin ™ Presentation addresses Gravity in the following manner:

- The very first yo-yo trick taught to a volunteer member of the audience is called the 'Gravity Pull' where gravity pulls the yo-yo down and the player pulls it back up.

- Another popular yo-yo trick, 'Reach for the Moon' is described as being difficult because the yo-yo is going against gravity.

- Gravity is also described as the force causing a gyroscope or spin top to fall off of one's hand or the string, if the object is not spinning.

9. Potential & Kinetic Energy. Although not specifically found in TEKS until Grade 7, these concepts of energy are addressed in science textbooks beginning in Grade 4 & 5. **The Science of Spin ™ Presentation addresses Energy in the following manner:**

- While demonstrating the diabolo skill toy, the transfer of potential energy in the muscles of the arm to the kinetic (or moving) energy of the arm, sticks, and string.

- Energy is then described as being converted into spinning energy of the diabolo through the use of friction between the string and the diabolo axle itself.

- Energy is described as never being lost. The most dramatic example is when a student stands on a lazy susan, holding a wheel which is spun. When asked to tip the wheel from a vertical to a horizontal position, the students spins around. Because the spinning object does not want to change its plane of spin (concept 1-gyroscopic stability), the energy it took to force it to change its plane transferred through the student's body, and spun him/her around.

10. <u>Scientific Method</u>. This concept is addressed in all grade levels 1-7 TEKS. The students are expected to be able to conduct simple classroom investigations, ask questions, gather information, make measurements and draw conclusions. The students are also expected to summarize their findings verbally and/or through the use of tables and graphs.
The Science of Spin ™ Interdisciplinary Curriculum contains simple experiments in both the Science and Math sections that may be used in the classroom which use the Scientific Method involving:

- measurement (TEKS Grades 1-5)

- drawing inferences related to functionality (TEKS Grades 4-5)

11. <u>Simple Systems</u>. This concept is addressed in grade levels 1-6 TEKS. The students should understand a whole in terms of its components and how these components relate to each other and to the whole.
The Science of Spin ™ Presentation addresses simple systems in the following manner:

- a yo-yo cannot work without a string and visa versa (as described in TEKS Grades 2-5 and most specifically in Grades 2 & 3)

- describe yo-yos with fixed axles vs. ball-bearing axles and the effect on performance. (TEKS Grades 4-5)

- describes Hubble Telescope and how telescope is ineffective without the gyroscope working inside of the telescope. (TEKS Grades 4-5).
The Science of Spin ™ Interdisciplinary Curriculum contains simple experiments that may be used in the classroom involving:

- sorting (TEKS Grade 1)

- fixed vs. ball-bearing axle and the effect on performance (TEKS Grades 3-5)

12. <u>Electricity</u> This concept is addressed in grade levels 4 and 5 TEKS. The student should understand that complex systems may not work if some parts are removed, such as a light bulb in a circuit.
The Science of Spin ™ product offerings frequently include a LED lighted Torch yo-yo. Students are encouraged to discover how this works (centrifugal switch making electrical contact when the yo-yo is spun). Activities are planned to be added to the Interdisciplinary Curriculum in the near future.

TEKS Specifics by Grade Level – Grades 1 through 5

The Science of Spin ™ program (assembly presentation and/or the Interdisciplinary Curriculum) address the following TEKS Objectives:

GRADE 1

1. **Friction**. TEKS states:
(Introduction (2)): "*Students observe that heat from the sun or friction is an example of something that causes change."*
Science of Spin ™ addresses friction when describing why a yo-yo or spin top eventually stops spinning and why a bicycle wheel eventually stops and falls over. Air friction (air resistance) is also discussed at length when describing the advantage of a flying ring variety of a flying disc vs. a Frisbee style flying disc. Friction is also determined to be the way that kinetic energy is transferred to the diabolo during the diabolo demonstration.

2. Scientific Method TEKS states:
(Introduction (1)): (1) "*The study of science includes… simple classroom and field investigations to help students develop the skills of asking questions, gathering information, making measurements using non-standard units…and drawing conclusions."*
Science of Spin ™ : Interdisciplinary Curriculum has simple grade appropriate experiments that can be done with yo-yos in the classroom utilizing measurement and the Scientific Method.

3. Simple Systems. TEKS states:
(Introduction(4)):"*Students should understand a whole in terms of its components and how these components relate to each other and to the whole."*
(b)(6) *"The student knows that systems have parts and are composed of… objects. The student is expected to sort objects according to their parts and characteristics; manipulate objects such as toys, vehicles, or construction sets so that the parts are separated from the whole which may result in the part or the whole not working; and identify parts that, when put together, can do things they cannot do by themselves…"* **Science of Spin ™ demonstrates that a yo-yo cannot work without a string, nor can a string cannot work without a yo-yo. Interdisciplinary Curriculum also has simple experiments to be done in the classroom involving sorting.**

GRADE 2

1. Scientific Method TEKS states:
(Introduction (1)) "*The study of science includes… simple classroom and field investigations to help students develop the skills of, making measurements using standard and non-standard units, using common tools such as rulers… classifying and sequencing objects, and identifying patterns."*

(b)(2.2-2.3) "*The student develops abilities necessary to do scientific inquiry in the classroom. The students knows that information and critical thinking are used in making decisions."*
Science of Spin ™ : Interdisciplinary Curriculum has simple grade appropriate experiments that can be done with yo-yos in the classroom utilizing measurement and the Scientific Method.

2. Simple Systems. TEKS states:
(Introduction (4)): "*Students should understand a whole in terms of its components and how these components relate to each other and to the whole."*
(2.7) "*The Student knows that systems have parts and are composed of objects. The students is expected to manipulate, predict, and identify parts that, when put together, can do things they cannot do by themselves, such as a guitar and guitar strings"*
Science of Spin ™ demonstrates that a yo-yo cannot work without a string, nor can a string cannot work without a yo-yo.

GRADE 3

1. **Force and Motion. Gravity.** TEKS states:
(Introduction (2)): "*Students…observe the direction and position of objects as they are pushed and pulled…as examples of change caused by a force. Students investigate…gravity."*
Science of Spin ™ : Presentation addresses gravity. "Gravity Pull" yo-yo trick where gravity pulls the yo-yo down and the player pulls it back up. "Reach for the Moon" yo-yo trick goes against gravity, rather than with it. We also address force when demonstrating a wheel continuing to spin on a particular plane until affected by some outside force, such as friction or another object. Gravity is also described as the force causing a gyroscope or spin top to fall off of one's hand or the string, if the object is not spinning.

2. **Scientific Method** TEKS states:
(Introduction (1)): "*The study of science includes… simple classroom… investigations to develop the skills of collecting information..making inferences, communicating conclusions and making informed decisions."*
(b)(3.2-3.3) "*The student develops abilities necessary to do scientific inquiry in the classroom. The students knows that information and critical thinking are used in making decisions."*
Science of Spin ™ : Interdisciplinary Curriculum has grade simple appropriate experiments that can be done with yo-yos in the classroom utilizing measurement and the Scientific Method.

3. Simple Systems. TEKS states:
(Introduction (4)): "*Students should understand a whole in terms of its components and how these components relate to each other and to the whole."*

(3.5.B.) "The student knows that systems exist in the world. The student is expected to observe a simple system and describe the role of various parts, such as a yo-yo and string."
Science of Spin ™ demonstrates that a yo-yo cannot work without a string, nor can a string cannot work without a yo-yo. Interdisciplinary Curriculum and presentation also discusses yo-yos with ball-bearings and the effect they have on performance.

GRADE 4

1. Electricity TEKS states:
(4.5): "*The student knows that complex systems may not work if some parts are removed…such as a light bulb in a circuit; the student is expected to predict and draw conclusions about what happens when part of a system is removed."*
Science of Spin ™ : The frequently used LED lighting "Torch" yo-yo has a battery operated circuit visible through its clear side disks. A bar causes contact with a post completing the circuit during the centrifugal force caused by the rotation of the yo-yo. Students are encouraged to discover on their own how this works.

2. Gyroscopic Stability. TEKS states:
(4.6): "*The student is expected to illustrate that certain characteristics of an object remain constant even when the object is rotated like a spinning top…"*
Science of Spin ™ : The fact that yo-yos, wheels, gyroscopes, spinning tops, diabolos (and other displayed objects) are all gyroscopic objects and have gyroscopic stability as long as they are spinning. A spin top is shown to appear as though it is not spinning as it remains stable and upright when spun. Examples of objects spinning on various planes are experimentally shown and proven to have these same properties.

3. Scientific Method TEKS states:
(Introduction (1)): "*The study of science includes… investigations using scientific methods, analyzing information, making informed decisions…"*
(b)(4.2-4.4) "*The student is expected to: - implement simple experimental investigations. - construct simple graphs, tables…and charts to organize, examine and evaluate information. - use critical thinking and scientific problem solving to make informed decisions. – draw inferences based on information related to promotional materials for products. - collect and analyze information using tools including…meter sticks..and demonstrate that repeated investigations may increase the reliability of results. "*
Science of Spin ™ : Interdisciplinary Curriculum has simple grade appropriate experiments that can be done with yo-yos in the classroom utilizing measurement and the Scientific Method. Presentation addresses differences in yo-yos, allowing the student to draw inferences based on information as it relates to functionality.

4. Simple Systems. TEKS states:
(Introduction (5)): "*Students should understand a whole in terms of its components and how these components relate to each other and to the whole."*
Science of Spin ™ demonstrates that a yo-yo cannot work without a string, nor can a string cannot work without a yo-yo. Interdisciplinary Curriculum and presentation also discusses yo-yos with ball-bearings and the effect they have on performance. Presentation also describes systems such as the Hubble Telescope and how the telescope is ineffective without the gyroscope working inside of the telescope.

GRADE 5

1. Gravity. TEKS states:
(5.12): "*The student is expected to identify gravity as a force..."*
Science of Spin ™ : Presentation addresses gravity. "Gravity Pull" yo-yo trick where gravity pulls the yo-yo down and the player pulls it back up. "Reach for the Moon" yo-yo trick goes against gravity, rather than with it. Gravity is also described as the force causing a gyroscope or spin top to fall off of one's hand or the string, if the object is not spinning.

2. Electricity TEKS states:
(5.8): "*The student is expected to demonstrate that electricity can flow in a circuit and can produce…light…""*
Science of Spin ™ : The frequently used LED lighting "Torch" yo-yo has a battery operated circuit visible through its clear side disks. A bar causes contact with a post completing the circuit during the centrifugal force caused by the rotation of the yo-yo. Students are encouraged to discover on their own how this works.

3. Scientific Method TEKS states:
(Introduction (1)): "*The study of science includes… investigations using scientific methods, analyzing information, making informed decisions…"*
(b)(5.2-5.3) "*The student is expected to: - implement simple experimental investigations. - construct simple graphs, tables…and charts to organize, examine and evaluate information. – draw inferences based on information related to promotional materials for products. - use critical thinking and scientific problem solving to make informed decisions, to collect and analyze information using tools including…meter sticks..and demonstrate that repeated investigations may increase the reliability of results. "*
Science of Spin ™ : Interdisciplinary Curriculum has simple grade appropriate experiments that can be done with yo-yos in the classroom utilizing measurement and the Scientific Method. Presentation addresses differences in yo-yos, allowing the student to draw inferences based on information as it relates to functionality.

4. Simple Systems. TEKS states:
(Introduction (5)): "*Students should understand a whole in terms of its components and how these components relate to each other and to the whole."* (5.5) *"The student is expected to describe some structures and processes that are found in a simple system…and describe some interactions that occur in a simple system."*
Science of Spin ™ demonstrates that a yo-yo cannot work without a string, nor can a string cannot work without a yo-yo. Interdisciplinary Curriculum and presentation also discusses yo-yos with ball-bearings and the effect they have on performance. Presentation also describes systems such as the Hubble Telescope and how the telescope is ineffective without the gyroscope working inside of the telescope.

GRADE 6

Specific TEKS topics addressed either in presentation or interdisciplinary curriculum.

6.4. The study of science includes conducting laboratory investigations using scientific method. Identify patterns in collected information using percent, average, range and frequency.
6.6. Students identify changes in objects including position, direction, and speed when acted upon by a force.
6.5. Students should understand a whole in terms of its components and how these components relate to each other and to the whole. All systems have basic properties that can be described in terms of…energy and matter…"
6.9. The student is expected to identify energy transformations occurring during the production of energy for human use such as electrical energy.

GRADE 7

Specific TEKS topics addressed either in presentation or interdisciplinary curriculum.

7.1-7.2. Use scientific processes in laboratory investigations to collect, analyze and make conclusions. Construct graphs, tables and charts to evaluate data.
7.6. Identify gravity as a force and component of the solar system.
7.6 Students use pulleys and levers to understand the relationship between force and motion. Students demonstrate that an object will remain at rest or move at a constant speed and in a straight line if it is not being subjected to an unbalanced force.
7.8. Students learn about kinetic and potential energy.
4. Students should understand a whole in terms of its components and how these components relate to each other and to the whole. All systems have basic properties that can be described in terms of…energy and matter…"
7.3. The student is expected to draw inferences basic on data related to promotional material for products and services.

PHYSICAL EDUCATION

Yo-Yo skill building benefits:

1. Eye-hand coordination
2. Catching skills
3. Value of practice and persistence
4. Fine motor development
5. Bilateral proficiency
6. Sequencing
7. Visual Tracking
8. Benefits to ADD/ADHD – constant feedback, focus of attention
9. Self-esteem builder