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| Station  „Figurierte Zahlen“  Teil 3  Arbeitsheft   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | |  |  |  |  |  |  |  |  | | Teilnehmercode | | | | | | | | |  |

Liebe Schülerinnen und Schüler!

Schon die alten Griechen haben Zahlen mit Hilfe von Zählsteinen dargestellt. Die Steinchen wurden zu unterschiedlichen Figuren zusammengelegt. Dadurch haben die Griechen wichtige Eigenschaften von Zahlen untersuchen und aufzeigen können. Auch noch viele Jahrhunderte später wurden mit Hilfe von Figuren und regelmäßigen Mustern mathematische Aussagen bewiesen.

Wichtig: Bearbeitet bitte alle Aufgaben der Reihe nach!



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|  | Zu dieser Aufgabe gibt es Hilfen im Hilfeheft. |
|  | Diskutiert hier eure wichtigsten Ergebnisse und fasst sie zusammen. |
|  | Zu dieser Aufgabe gibt es eine Simulation oder ein Video. |
|  | Zu dieser Aufgabe gibt es Material auf eurem Tisch. |

Wir wünschen Euch viel Spaß beim Experimentieren und Entdecken!

Das Mathematik-Labor-Team

Wie ihr euch sicherlich vorstellen könnt, gib es neben den Dreiecks-, Quadrat- und Rechteckzahlen noch weitere figurierte Zahlen.

Habt ihr schon einmal im Supermarkt darauf geachtet, wie Obst oder Pralinen manchmal pyramidenförmig gestapelt werden? Solche Anordnungen wählt man, weil sie platzsparend, besonders stabil sind und außerdem schön sind.

Einige figurierte Zahlen lassen sich in einer ähnlichen Weise darstellen, also in Form einer räumlichen Figur. Ist die Grundfläche dreieckig, so erhält man die sogenannten **Tetraederzahlen**.

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| Foto 2.JPGMaterial   * 2 Legebretter (auf beiden   Seiten benutzbar)   * Holzkugeln in zwei Farben * zwei Holzpinzetten (zum   Greifen der Holzkugeln) |  |

Tetraederzahlen lassen sich gut auf den Legebrettern darstellen:

3.1a Legt zu zweit auf dem Legebrett (Seite A) die Dreieckszahl D4 aus. (ein Legebrett pro Pärchen)

3.1b Ergänzt die Dreieckszahl D4 (aus der vorherigen Aufgabe: Aufgabe 3.1a) zu einer Pyramide.

Damit habt ihr eine Tetraederzahl räumlich dargestellt. Um welche Tetraederzahl es sich dabei genau handelt, hängt davon ab, aus wie vielen Schichten und Kugeln das Gebilde besteht.



3.2 Vervollständigt die Tabelle mit den ersten Tetraederzahlen. Achtet besonders auf die Veränderung von einer Tetraederzahl zur nächsten!

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| **Bezeichnung**  **Tetraederzahl** | T1 | T2 | T3 | T4 | T5 | T6 | T7 |  |
| **Tetraederzahl** | 1 | 4 | 10 |  |  |  |  |  |
| **Veränderung** | **+3** | | | | | | | |
| **Dreieckszahl** | 1 |  |  |  |  |  |  |  |
| **Bezeichnung Dreieckszahl** | D1 |  |  |  |  |  |  |  |

3.3 Welchen Zusammenhang zwischen Tetraederzahlen und Dreieckszahlen erkennt oder vermutet ihr? Tauscht euch in der Gruppe aus und notiert eure Überlegungen hier.

3.4 Beschreibt die Tetraederzahlen mit Hilfe der Dreieckszahlen.

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| T1 = D1  T2 = D1+\_\_\_\_  T3 =  T4 = |

T4 besteht schon aus 4 Summanden. Je größer die Tetraederzahl wird, desto mehr Summanden besitzt die Summe. Also ist es sehr aufwendig große Tetraederzahlen so zu berechnen.

Allgemein lässt sich eine beliebige Tetraederzahl wie folgt berechnen:



3.5 Berechne T7 mit Hilfe dieser Formel.

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Ihr könnt euer Ergebnis an der Tabelle aus 3.2 kontrollieren.

3.6 Wie kann man eine Tetraederzahl aus ihrem Vorgänger berechnen.

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| T2 = T1‘ + \_\_\_\_  T3 = T□ + \_\_\_\_  T4 =  T5 = |

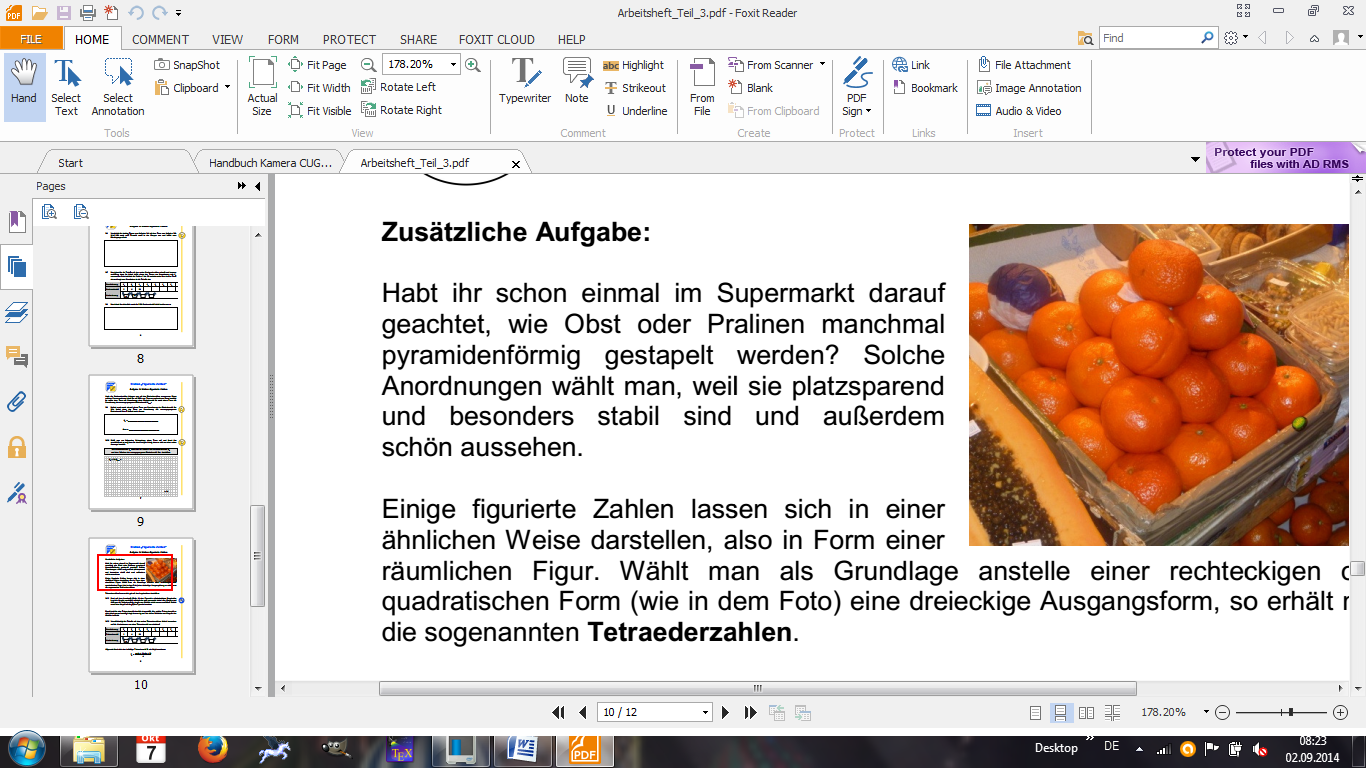
3.7 Stellt wie in Aufgabe 3.6 mit Hilfe von Tn einen Term für Tn+1 auf.

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Es ergibt sich durch Einsetzen in die Formel für Tn:

3.8 Zeige durch Termumformungen, dass die Formel aus 3.7 mit der Formel für Tn+1 übereinstimmt.

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Nicht nur aus Dreiecken kann man eine Pyramide aufbauen, sondern auch aus Quadraten.

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| IMG_0667.JPGMaterial   * braunes Legebrett (Seite C) * Holzkugeln in zwei Farben * zwei Holzpinzetten (zum   Greifen der Holzkugeln) |  |

3.9 Legt die ersten vier quadratischen Pyramidenzahlen nacheinander auf eurem Legebrett (Seite C) aus.

Wir verwenden für die erste quadratische Pyramidenzahl die Abkürzung , für die zweite usw.

3.10 Füllt die Tabelle aus.

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| **Bezeichnung**  **Pyramidenzahl** | P1 | P2 | P3 | P4 | P5 | P6 | P7 |  |
| **Pyramidenzahl** | 1 | 5 | 14 |  |  |  |  |  |
| **Veränderung** | **+** | | | | | | | |
| **Quadratzahl** | 1 |  |  |  |  |  |  |  |
| **Bezeichnung**  **Quadratzahl** | Q1 |  |  |  |  |  |  |  |

Im Lehrbuch findet man für die Berechnung der quadratischen Pyramidenzahlen folgende Formel: .

3.11 Berechnet mit Hilfe der oben angegebenen Formel und vergleicht den Wert mit eurem Ergebnis aus der Tabelle.

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3.12 Nora behauptet, dass man die quadratischen Pyramidenzahlen auch mit folgender Formel berechnen kann:

Zeige mit Hilfe von Termumformungen, dass beide Terme äquivalent sind.

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3.13 Ein Obsthändler möchte 56 Äpfel möglichst platzsparend stapeln. Sollte er die Äpfel als Tetraederzahl oder als quadratische Pyramidenzahl darstellen. Überprüft eure Vermutung mit Hilfe der Formeln, in dem ihr ein passendes n in die richtige Formel einsetzt.

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3.14 Während des Stapelns bekommt der Obsthändler Hunger und isst einen Apfel. Wie muss er diese nun aufstapeln? Überprüft eure Vermutung mit der Formel.

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Variante A

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